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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

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Foundry Pig-iron.

Whenever trade depression causes the damping down of an abnormally large number of blast furnaces, then we receive complaints of irregularity in the composition of consignments. This is operating at the present time. Foundrymen have sufficient difficulties without having to do work which is obviously the duty of the furnaces. Some furnaces are seriously trying to meet the wishes of the foundry trade by either keeping reasonably to an established composition or to selling against a stock list of specified compositions. It is the malleable foundry which is worst off at the present time. Some are hesitating to adopt the American black-heart system because they feel too insecure as to the regular delivery of suitable irons. Those established in this industry rely very largely on imported iron. It is interesting to note that Indian iron is finding its way into the British market, one type going to Scotland and another to the Black Country. We believe British pig-iron to be equal if not superior to any other, because of speed of working, accumulated experience and technical control, but British furnaces draw their ore supplies locally and from France, Spain, Sweden, Africa and Newfoundland, whereas many countries merely draw from the one source. Thus, from the foundry point of view, it seems desirable that the furnaces should make their pig-iron, classify it according to analysis, make up a stock list and sell from that. Time after time has it come to our knowledge that a foundry is requiring an iron which fails to fit into any advertised composition, yet we have felt that stocks of the type wanted did exist, if only they could be found. Cast iron, being normally a six-element alloy, is always capable of being mixed so as to neutralise any abnormally high or low constituent. Modern foundrymen are quite capable of doing this, if they only received advance information.

Another complaint which has reached us is that the majority of low-silicon irons contain chromium. If any of the blast furnaces have extensive information to the contrary, they would do well to make the foundries aware of it. If, on the other hand, a fair amount of chromium is found to be present, again they would be well advised to broadcast it. But if merely traces are present, they should take steps either to eliminate it or increase its quantity after consultation with the users.

There are other blast furnace plants which, when busy, absorb all their output domestically and sell to the foundries when trade is depressed. We suggest that when conditions again become favourable they should reserve a certain proportion of their output for "slack time" customers, even though it involves buying pig-iron from outside sources, because their customers may acquire a habit of using imported iron, which will react against them when the cycle of trade takes once more a downward trend, and so unbalance the conduct of the works.

INSTITUTE OF BRITISH FOUNDRYMEN.

DISCUSSION ON CONVENTION PAPERS.

(*Continued from page 558.*)

LOW-TEMPERATURE HEAT TREATMENT OF SPECIAL CAST IRONS.

By J. W. DONALDSON (GLASGOW).

MR. FLETCHER observed in opening the discussion that the Paper, in conjunction with the author's earlier work on the subject, would be appreciated by all who had anything to do with the low-temperature heat-treatment of special cast irons. It seemed to him that those of the members who were interested in the heat treatment at low temperatures that the results obtained by the author bore out the work that had already been done in other directions. Indeed, if one might suggest a further series of tests, it would be on similar irons caused under "Perlit" iron conditions. That point was to be raised at another session of the present year's conference. His own personal view of the issue raised was that they ought to normalise before they began their tests and expected to derive results. In other words, they would have to begin a series of experiments of this kind from the dead level of "Perlit" iron. He was ready to agree with what the author had said as to the influence of nickel-chromium. Work which he (Mr. Fletcher) had done a few years ago rather demonstrated to him that the best results were got with cast iron with about ½ per cent. of chrome. Of course, those of them who had to do with general foundries knew that chromium sometimes was not an unmixed blessing. Indeed, his advice to foundrymen would be to see that their scrap was taken care of, so that it did not become mixed with other castings. If that was not done, then he could easily conceive something happening which would neutralise all the apparent benefit. He agreed with Mr. Donaldson in keeping his chromium down to the neighbourhood of 0.5 per cent. He further endorsed the author's suggestion respecting silicon as a means of reducing accidental hardness.

MR. F. J. COOK felt the members would all be in agreement as to the value of the Paper, but he was desirous of asking the author why he settled on 450 deg. C. and 550 deg. C. Perhaps Mr. Donaldson would say whether his choice was accidental or specific. His suggestion, however, would be this—that Mr. Donaldson should continue this work for the benefit of the members and submit conclusions and findings as to the structures of the various irons. He (Mr. Cook) was quite convinced there was more in the structure of the metal than in the actual chemical analysis. He made that remark advisedly and as the outcome of a great deal of experience derived from experiments which he had carried out.

He recalled an instance with two irons of similar chemical composition, one of which was cast in the ordinary way and the other in chill. Both samples were subjected for some years to superheated steam of possibly 550 deg. One engine had a condenser and the other had not, and after an interval of years, when the particular samples were polished it was found that the results were totally different—there being distinct signs of corrosion in one case and not in the other. The experience was a very practical one to him, but it confirmed him in practice which he had carried out for many years, namely, that of chilling cylinders, and particularly those which had to stand up to superheated steam. The same fact had emerged in connection with engines working regularly with superheated steam, namely, that where there was a chill in the cylinders there was no sign of corrosion or erosion. It was because of these results that he suggested to the author it would be for his own advantage and that of the members if he looked particularly into the structure of the iron. Mr. Donaldson's work and experiments seemed to prove that they did get better results from chromium than from manganese. He agreed that the physical properties were as good, and his own experience rather tended to show that the wearing properties would be greatly increased.

Comparative Value of Chrome Additions.

MR. H. J. YOUNG observed that the author had referred in his Paper to annealing tests and growth tests. His view on that point was that the annealing tests were in reality growth tests. Indeed, on that particular point he felt it was rather a pity the word "annealing" should have crept into the Paper at all in the sense that it was intended. Dealing with the influence of chromium, Mr. Donaldson made the following point:—"Even after stable conditions are attained by annealing the chromium iron at 550 deg. C., the final tensile strength is similar to that obtained in the cylinder iron as cast." Supposing that cylinder iron had contained one-half per cent. of silicon instead of 1½ per cent., he (Mr. Young) did not consider such a remark as the foregoing could have been possible. As to the addition of nickel, he thought it had no practical influence on pig-iron at all up to a certain silicon content. There was no real use at all in the addition of nickel there, because obviously they knew what the result was to be. It seemed to him that if they desired to ascertain the effect of nickel they had to take away the silicon and watch for effect. No doubt it would be an expensive business to compare cast iron without any silicon and with the addition of nickel instead, but he submitted that it would be a far more fair comparison than the one outlined in the Paper. At a later stage of the Paper and under the heading of "Consideration of Results," the author ventured the opinion that a small percentage of chromium, about 0.4, produced the best results. Then he added: "It might be noted here that this percentage of chromium was the maximum amount that can be added to an iron of the composition experimented with, larger amounts producing irons so hard that difficulty is experienced in machining them." He did not see that that statement was justified with a hot mould, because surely it was possible to produce machinable iron? Then the author mentioned that chromium iron showed contraction in certain cases instead of growth. He personally believed there were a number of irons on the market at the present moment that were showing contraction in that way. It applied not only to chromium iron but to other irons. That he considered was a serious matter for the makers and users of Diesel engines. Indeed, he knew of one Diesel engine manufacturer who would not look at chromium iron on that account. Mr. Donaldson made a further remark in his summary to the effect that the material had to be annealed at the working temperature until the carbide change was complete. He suggested to the author that the carbide change as explained in the paper could not have been complete at all. If the statements made as to the heatings and coolings were carefully analysed and the figures critically examined it would be found that the carbide changes were not quite so complete as the author's contribution assumed them to be. He agreed with Mr. Cook that structure ought to be determined, and on that point he suggested that two important elements had to be considered—what is in the iron and how does it act? Mr. Young thereafter entered into a criticism of the author's tables, and suggested reasons why they might be inconclusive. In conclusion, he was desirous of saying how much he appreciated the effort that must have been expended on a Paper of this description. How many amongst them would undertake a research of the nature revealed in the contribution? The work was altogether of intense value, especially to those members of the Institute who were dealing with and looking to the future of cast iron.

Contraction of Chromium Cast Iron.

MR. J. S. GLEN PRIMROSE (Manchester) asked if the author could inform the members if he had determined what loss of chromium and nickel he had found by remelting the Mayari pig-iron. In view of the importance of rate of heating-up on the amount of graphite separated it would be interesting to know how quickly the bars named on page 13 of the Paper had been treated, as the slower the rate the more was the carbon precipitated, and also the greater the volume of growth. The low grade foundry iron named on page 17 of the Paper seemed a poor comparison to make, as the rates of manganese to sulphur seemed ridiculously low. He would like to know if the author could explain the mechanism of the change on annealing the chromium alloy iron which was said to show a contraction instead of a growth on repeated heating, especially as Professor Levi quoted Drs. Andrew and Hyman as finding that chromium reduced expansion without entirely preventing it. It would be invaluable to know if the author could give any explanation of what the contraction of the chromium iron named on page 20 of the Paper was due to on repeated heatings and coolings to 550 deg. C.

DR. ANDREW, referring to the question put by Mr. Primrose, said he took it that after the heating a considerable amount of scale fell off. Certainly when Dr. Hyman and he carried out their work on this investigation they found that the scale differed with the different classes of iron. Some of the scale fell off very quickly. He should like, if at all possible, that the author would throw additional light on this part of his Paper. His tests had rather gone to show that not only did they get oxidation of the surface, but oxidation took place by wearing of the graphite.

Dr. Hyman and himself had considerable evidence before them at the time that the graphite showed oxidation. Mr. Donaldson might also explain whether he found any relationship between the graphite flakes and the growth, because Dr. Hyman and he had discovered that the larger the former flakes were the more intense was the growth.

MR. J. G. PEARCE, Director, B.C.I.R.A., Birmingham, asked the author what method it was proposed to pursue for rapidly discriminating between two irons?

Annealing of Cast Iron.

MR. J. SHAW (Sheffield) said that so far as his own experience had gone the addition of chromium did not add to the strength of iron in test-bar work, but if they were dealing with large bodies he believed it did have a beneficial effect. He agreed entirely with the author in the observations he had made respecting people annealing castings without knowledge. An instance of that kind had been brought to his notice in regard to test-bars. They could not send out too strong a warning against the futility and waste of annealing without judgment and knowledge.

THE PRESIDENT remarked that as this Paper proceeded and developed along the lines of original research and presented its experiments, tables and conclusion in a systematic manner, it was one of the most valuable types of contributions that could be put before them.

The Author's Reply.

MR. J. W. DONALDSON said he was personally rather sorry he used the term annealing. In reality the wrong word had been used. Perhaps it would have been better for him to have referred to it as "heat treatment." After all was said and done, the tests were not annealing tests. Generally speaking, they regarded annealing as prolonged heating, but in the present instance where, as the Paper clearly indicated, there had been repeated heatings and coolings, the phrase "heat treatment" would have been preferable to the use of the word "annealing." He supposed that that statement would now have the effect of removing a large amount of misconception. When writing the Paper he had not sufficient data at hand regarding the micro-examinations of the various irons. He had now obtained a certain amount of data on that point which would enable him to carry on his tests and develop them still further. In reply to what Professor Andrew had said, he had to mention that there were indications of oxide, and there was certainly a relationship between the graphite flakes and the extent of growth taking place. He would develop that point when he dealt with the question of micro-examination. Something had been said in regard to pearlitic iron, and his view was that the irons should be judged from their micro-construction more than from their chemical analysis. It was desirable, he thought, to have iron containing more or less such pearlitic structure as would maintain it in heat treatment. That might be done by the addition of chromium, manganese or tungsten. The first point, however, was to get a pearlitic structure, and to get it as nearly as possible amenable to heat treatment. Such other questions as had been raised in the course of discussion he would endeavour to deal with satisfactorily in a written communication.

MALLEABLE IRON.

By F. H. HURREN, A.I.C. (MEMBER).

MR. W. H. POOLE said he was well aware that many years ago the author was engaged in a research of malleable iron, and so it had afforded him much pleasure to hear this Paper read. There were, however, a few practical points connected with the contribution which it might not be at all disadvantageous to raise. He had been particularly interested in the tables giving the results of carbon content varying with silicon. He did not suppose the author would exclude the influence of gas—the oxidising of the gas atmosphere—but he should like to ask Mr. Hurren if in the samples demonstrated with the other elements were identical. The notes on the question of carbon content were most valuable, but the difficulty at the present time, and it struck most of them very forcibly, was to get a pig-iron capable of supplying a suitable carbon content. Then another point he was desirous the author should enlarge upon was dealt with in one or two paragraphs throughout the Paper where reference was made to primary graphite. In some of the higher silicon irons, in spite of any obvious reason, primary graphite exercised a big effect on the annealing result. He was quite in agreement with the method suggested in the Paper of "soaking," but in the course of investigation he had been somewhat surprised to find firms who maintained the continuous temperature for the full time actually taking their "soaking" periods during the process of annealing. As a result of the work Mr. Hurren had carried on, he would be glad to have information from him as to the possible effects of varying lengths of time in actually heating up. Then in regard to the condition of ore, his suggestion would be that there ought to be a periodical test of the actual black ore used in the process. On that point he wondered if Mr. Hurren could advise any method by which black ore could be maintained up to correct conditions. It would be interesting to practical men if there could be an elucidation of one other point, namely, as to whether there was any increase in sulphur. Sometimes in testing black ore he had found sulphur, and in one instance there was 7 per cent. of it. Did Mr. Hurren consider that would be harmful in the ultimate annealing?

MR. HARLEY remarked that many years ago he came to the conclusion that the use of malleable iron in the automobile industry was dying out, and the trend of events since had proved his contention right up to the hilt. He was speaking now for a large firm of motor-car manufacturers—the largest producers of motor cycles in the country, by the way, their output aggregating something like 40,000 a year—and in their productions they had cut out malleable iron altogether, simply because it was not a reliable material. On that particular aspect of the question he did feel that its unreliability was very clearly indicated in the Paper now being discussed by the Institute. Of course, in the first instance it must be understood they were discussing English white-heart malleable, because he was ready to admit that the observations he was about to make might not equally apply to black-heart malleable. Mr. Hurren, in the Paper, had clearly shown the difficulty of getting pig-iron of the right composition for this

work. He did not need to point out the difficulty of ensuring the exact composition in ordinary cupola melting. It was bad enough with grade iron, but there was infinitely more difficulty with malleable. Then with regard to the varying sections of patterns, he gave it as his opinion that it was a sheer impossibility to anneal correctly. If there was a varying section from one inch to a quarter of an inch, experience had shown with malleable iron that if the annealing was correct for the ¼-inch section it was useless for the inch section. He would go further and say that, as the outcome of his own practical knowledge, it was not possible with malleable iron to anneal a suitable casting to one inch section. At the present time it seemed to him they were not producing malleable but simply a kind of superior cast iron. He proved these contentions many years ago in a Paper he submitted to the Birmingham branch of the Institute. Some twelve or fourteen years ago he obtained samples from all the leading makers and from the facts he brought out then he showed pretty conclusively that malleable iron as compared with cast steel could make no show whatever. The steel process in the automobile industry was, in his opinion, a very simple one compared with that of annealing malleable iron. It was not to be understood that he was principally criticising this, but he was speaking with a view to getting the members of the Institute to consider this question for themselves. It was possible to prove from exhaustive research work on material that in regard to the important automobile industry, at any rate, the only people who were using malleable were those who could not get hold of cast steel. He regarded it as inevitable that malleable iron as made in this country by the white-heart process would become obsolete. For obvious reasons, and chiefly because he did not consider it was worth while, he had not gone into the various points raised by the author in his Paper.

MR. E. LONGDEN (Birmingham) said he was desirous of asking Mr. Hurren whether he had been successful in producing black-heart malleable iron in the cupola. Personally he had been nearly successful, but not quite. A point had been raised with regard to the condition of the ore, but he saw no difficulty on that score.

MR. J. G. PEARCE (Birmingham) said he for one refused to be scared into believing that the death-knell of the malleable iron industry had been sounded by the speaker of a few minutes ago (Mr. Harley). The Paper itself was a very good answer to some of the criticisms Mr. Harley had put forward. Towards the close of his contribution, Mr. Hurren inquired whether the British Cast Iron Research Association had the power, ability or financial resources, together with the necessary moral courage, to face up to a big research. To answer that query, he would refer them to three important points in connection with the malleable iron trade. Firstly, the number of producers was large; secondly, the average plant was small; and, thirdly, many of them lacked technical control. It was the second of these conditions which produced the results of which Mr. Hurren complained, but those of them who were connected with the British Cast Iron Research Association did not intend to let the position go by default. They were in close touch with the laboratories in various parts of the country, and they could arrange for experimental work on a commercial scale. The Association was fortunate in having a number of members who were interested in malleable production, and they were supplying some details of excellent results in practice. But the Association was even more fortunate still in its Malleable Committee, and an investigation had been commenced into the total carbon of white-heart malleable iron. Of course, the extent to which that could be carried out depended largely on the support that would be forthcoming from the malleable iron industry. He hoped that support would be readily forthcoming, because it was a task of some physical difficulty to get round so many different producers even in a comparatively small area. The particular material they were discussing at the moment was threatened with competition, not only from steel and casting steel, but from those other types of cast iron that were now beginning to receive so much attention. It would be a great pity to those employed and to the capital involved in the industry if it should be eliminated. They of the Cast Iron Research Association believed there was a field for such a research as he had indicated, and they considered further that it ought to be extended to its fullest possible limits. They did not see why this trade should be weak, especially when other branches of industry were able to maintain an organisation such as the Cast Iron Research Association. The latter had the technical facilities, and it was willing to undertake necessary research work if only manufacturers would support it by making themselves responsible for the comparatively small expenditure involved.

MR. F. J. COOK said he also took exception to Mr. Harley's prediction regarding the ultimate position of the malleable iron industry in this country. Mr. Harley practically said that the malleable iron industry was dead, but he might point out to him that he knew of a large firm, specialising in motor cars, who at the present time used tons of malleable iron. It was far from going by the board, and personally, he could not see why a research could not be undertaken which would go a long way towards the re-building of a poor and downtrodden trade. He certainly agreed with Mr. Hurren as to the points he had raised relative to the effect of total carbon and the condition of primary graphite. These were two very important points. In any research which was to be undertaken they ought to consider the possible elimination of sulphur from the cupola process. He did not look upon that as an impossible proposition. If that and a few other points suggested by Mr. Hurren in his Paper could be dealt with they would go a long way towards raising the malleable iron industry to a higher condition than Mr. Harley thought it was at the present time.

MR. F. H. HURREN, in replying, said he should like to thank Mr. Poole for opening the discussion. He did so particularly for the reason that he did not wish to remember how many years ago it was now since Mr. Poole came to him as a very junior assistant. In the interval they had both got considerably older and, he hoped, wiser. With regard to the point raised as to the influence of the atmosphere in the furnace, he did consider that the annealing pans were impermeable to furnace gases, but no doubt the atmosphere in the furnace was a very important factor in the annealing. In Table I "the other elements" which were not enumerated were practically identical in both cases. He had been rather interested to hear that a firm starting with a total carbon of 2½ per cent. got such very good results. Regarding the question of the various lengths of time in heating-up, he had this to say that the heating-up period was a very important one. Rapid heating-up in his opinion invariably induced complications, and he believed that point had been pretty well brought out by one of the Institute's members at a recent meeting of the Iron and Steel Institute. With rapid heating-up there was a greater danger of boiling, and his own experience had been that a period of not less than from 32 to 36 hours should be taken between the commencement of the operation and the maintaining of an annealing temperature of 900-950 deg. C. From past experience of Mr. Harley—and he had considerable arguments with him—he knew that gentleman was not an enthusiast of malleable iron. He would, however, point out that although cast steel might be superior so far as the physical properties were concerned, it was not an easy material to manipulate. Furthermore, the expense in the upkeep of plant was considerably higher than that of the malleable iron foundry. One gentleman had pertinently asked in the course of the discussion why sulphur, if it retarded annealing, should be used in the annealing pans at all. That was a suggestion that was worth considering. Speaking for himself, he (Mr. Hurren) had not been able to obtain good black-heart material from the cupola, but he considered this was a research that was highly necessary. He believed this was an industry of very considerable importance in the Midlands. It employed a large number of men, but unfortunately haphazard or rule-of-thumb methods were adopted. It did seem to him that a research which ought to be a fairly simple thing would be of inestimable benefit to the malleable trade.

HEAT-RESISTING CAST IRON.

BY MONS. ANDRE LEVI (FRANCE).

Author's Recommendations Criticised.

MR. H. J. YOUNG (Newcastle-on Tyne) remarked the author had presented certain conclusions, and quite frankly he had to say that he did not agree with many of these at all. In the first of his formulæ he gave T.C., 3.0; C.C., 0.5; Mn, 0.9; S, 0.15; P, 0.5 to 1.5; and Si, 2 per cent. Candidly he (Mr. Young) did not know how the author succeeded in getting iron on that formula, and most certainly he said nothing at all about the cupola practice. For one thing, 2 per cent. of silicon was most undesirable. Most of the other percentages were equally undesirable, and he could not understand why something entirely different from accepted practice should be recommended. Later on, he ventured an opinion that many specialists, French and English, recommended a silicon content of about 2.20 per cent. He (Mr. Young) did not call himself a specialist, and he, for one, would not recommend it. The author, under the heading of metal for Diesel motor castings, referred to a temperature approximating 650 deg. C.—which, by the way, was one of the highest temperatures in Diesel engine work—and suggested a silicon content of 1.8 to 2 per cent. for that. In that paragraph he wound up thus:—"For these castings, therefore, the author recommends the use of semi-steel cast iron with high Mn content." A statement of that kind meant absolutely nothing at all, and the author might just simply have recommended the use of pig-iron. He (Mr. Young) felt that he could speak for the work done in this country, and he did not think there was agreement in Britain that the high silicon content the author recommended was used in connection with Diesel engine practice. The high silicon content was very little used in superheater work. He made these observations as the result of his experience, and he should like the author to know that he was being contradicted on certain points.

MR. F. J. COOK said he quite agreed with a good deal that Mr. Young had said. The author emphasised the point that the formation and size of graphite was of importance. In the earlier part of the Paper the author made that abundantly clear, and on page 15 he was responsible for the statement that there ought to be a reduction of the amount of graphite by every possible means. The conclusions of the author, therefore, rather bore out what he (Mr. Cook) had said in a previous Paper. He must, however, join with Mr. Young in condemning the analysis that was given for Diesel engine practice, because it was in every way contradictory to the methods adopted in this country. Moreover, he was going to claim that the castings made for Diesel engines with high temperatures in Great Britain were superior, or at least equal, to anything produced in that line on the Continent. Already he had dealt with this particular aspect of the question, in the Paper which he contributed to the North East Coast Institution of Engineers and Shipbuilders. On that occasion he stressed the necessity for small graphite. Then on the question of silicon content he personally should not recommend for Diesel engines any silicon content in excess of 1.2 per cent. There were circumstances, too, when they need not be afraid of silicon content up to 1 per cent. In Great Britain they were not altogether conservative regarding the practice of the past, and possibly some of the younger members of the Institute might find it advantageous to pursue an investigation of this kind.

MR. J. S. GLEN PRIMROSE (Manchester) desired to know on what evidence Professor Levi stated on page 8 that the metal cast iron was not permeable to gas at high temperatures, whereas steel was very highly permeable. Although the statement was made that low total carbon was needed for fine-grained iron, the very desirable formation of early graphite iron was not necessarily dependent upon this, but chiefly on the casting rate. The recommendation to make Diesel motor castings with about 2 per cent. silicon was not in conformity with the latest and best practice in making maximum pearlite plus curly graphite castings where the reduction of 1 per cent. of silicon and under was found highly desirable.

Graphite or Pores as Chief Factor.

MR. FLETCHER felt that in the general criticism the members ought not to ignore the valuable fore part of the Paper, especially in its reference to the recent work of Japanese metallurgists. The question of porosity in cast iron was of vital importance, because they were often too apt to take graphite as being entirely responsible for all the troubles. There was something in the point mentioned by Mr. Young that the space occupied by the graphite was a space that was not absolutely filled by that graphite. Round the edge of the graphite plate was a certain amount of porosity. It would be recalled that many years ago an ex-President of the Institute made the remark that there was no gas in cast iron. Things had progressed a good deal since then, and he thought it would be acknowledged that the influence of gas pores on the heat-resisting properties of iron was very considerable. There was no disputing the fact that the first part of the Paper was of extreme value, but he was just afraid, so far as the formulæ was concerned, that British foundrymen would take great exception to the analyses proposed.

Theory of Chromium Cast-Iron Contraction Phenomenon.

MR. J. W. DONALDSON said he had read Professor Levi's Paper with considerable interest, and he regarded it as a very valuable contribution to the literature on this important subject of cast-iron heat treatment, particularly with reference to growth. The various deductions he had drawn from the numerous investigations carried out would be, he thought, generally accepted by all foundrymen. Professor Levi attributed the growth of cast iron after repeated heatings and coolings first to decomposition of cementite and second to internal oxidation and change in the metal at the critical points. While this no doubt took place with most irons, he would be pleased to have his theory as to what took place at low temperatures —440 to 550 deg. C.—with irons containing chromium where there was a contraction in volume accompanied by a decomposition of cementite. With reference to the composition suggested for Diesel engine castings, he would prefer a lower total carbon, say, 3 per cent., and a lower silicon content, say, 1 to 1.3 per cent., in order to increase rather than to lessen the proportion of combined carbon. The nearer it was possible to obtain a pearlitic structure under heat treatment by the addition of more manganese or by a small percentage of chromium or tungsten the better was the heat-resisting properties of iron and the smaller the change in volume.

THE PRESENT STATUS OF THE LABORATORY INVESTIGATION OF SANDS.

BY PROF. H. RIES.

MR. H. J. YOUNG (Newcastle-on-Tyne) thought that this Paper, so far as it related to moulding sands, was apt to lead to confusion rather than conclusion. He had one criticism to offer and it was this, that nearly all the tests they heard about in this Paper had been on cold sand. Moreover, he was bound to add that there was an intense difference between tests in a laboratory and noting the behaviour of sand in actual foundry practice and at the moment the metal touched it. He had done certain other tests than those mentioned or described in the Paper, and personally he had not been able to find any conclusive evidence that gases passed through the sand. They placed a pyrometer two inches or two and a-half inches off the metal, and it showed no indication of any temperature rise whatever. If the gases were rushing through the sand as one had been led to imagine, the pyrometer would surely have indicated it. They had no indication whatsoever of that, and the pyrometer, they must not forget, was only a short distance away from the metal. He doubted if the author had got sand that was really permeable yet, and indeed if such had happened, how was it going to hang together for moulding purposes? Frankly, he did not believe that the tests referred to were permeable tests at all. They might be, but up to the present he had not thought it worth while to try any of

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them in his own laboratory. He supposed he would probably be severely jumped upon for ventilating these views, but he felt he must express his personal opinions on this Paper.

MR. J. LONGDEN said he was not proposing to take part in the discussion of the Paper itself, but he felt he must rise to reply to a remark made by Mr. Young. It did not matter whether the sand was permeable or not, the gases did get away.

MR. H. J. YOUNG: The permeability of the sand, I claim, has nothing at all to do with that.

A question arose in the meeting at this stage as to whether Mr. A. Rydderech, who had presented a summary of the Paper on behalf of Dr. Ries, could competently reply to the discussion. The President ruled that Mr. Rydderech could reply to the discussion and the points raised if he was particularly anxious to do so.

MR. J. E. FLETCHER (Dudley) said he felt they ought to look at this Paper in the light of the valuable American work that had already been done, and they must judge of the value of that work by the ability with which this Paper was presented. To his mind it represented a comprehensive knowledge of sand-moulding research not only in America but in every part of the world. Touching first of all on the problem of permeability, which had already been dealt with by Mr. Young of Newcastle, he thought if they looked at the very elementary composition of sand and its building up they must realise that between sand grains there existed a number of voids. These voids had to be filled with air to begin with, and when the heat application came along the air between the grains began to expand. If that air expanded it must get somewhere, and being driven outwards it must naturally lower the pressure at the end of the spaces between the grains. The very fact of that lowering of pressure meant a vacuum which drew the gases that were liberated at the moulding face to the sand. There could be no disputing the fact that the question of permeability was of utmost importance and value. Some years ago he made a series of tests on the permeability of sand, while he also investigated the temperature gradient from the surface of the mould outwards. His experiments were made on moulds of varying thickness, and he found that permeability was obviously related to temperature. Personally, he had the feeling that permeability tests had not up till now been satisfactory for the reason that Mr. Young had raised. The most of their permeability tests had been carried out on cold sands. At the moment he was carrying out on behalf of the Cast Iron Research Association a series of tests, and they were trying to find out what the permeability was of the surface of the mould itself under actual conditions. It was a very difficult problem, and he was bound to say so far as they had gone it showed very valuable results. Mr. Young had raised a very important point in regard to the dual character of sand examination. The Paper itself referred to laboratory analysis. As foundrymen, however, they wanted to know something more about the behaviour of sand under actual working conditions. If simple tests could be continued to show a co-relationship, he personally believed that useful results for the foundry could be got. Dr. Ries, in his Paper, alluded to the Smith vibratory test. It was very similar to the one that he (Mr. Fletcher) had brought forward, and consisted simply of agitating sand in a certain volume of water contained in a tube. As the sand gradually fell in the tube one got a curve. They could plot the curve on a time basis. These tests, up to the present, had been most useful, and he might mention that from the simple test he had referred to it was possible to get a certain idea of the porosity of the sand. That could be done by shaking a certain amount of sand in the water and noticing the drop of the water on the top of the tube. At this point Mr. Fletcher proceeded to the blackboard and gave an interesting demonstration of a process by which separation could be effectively carried out in the sand. He explained that by the funnel arrangement which he showed on the blackboard it was possible to get the correct sand grade and what it was capable of giving. He was hopeful, at least so far as permeability was concerned, that they of the Cast Iron Research Association would be developing along the lines he had indicated in his blackboard sketch.

A question was asked of Mr. Fletcher when he was illustrating his sketch on the blackboard as to how he got the area at the bottom part. Mr. Fletcher's reply was that there was not the slightest difficulty about area.

MR. SUTCLIFFE (Lancashire), in a characteristically humorous speech, related a few of the difficulties peculiar to moulders in the use and application of sand. He narrated an instance where he asked an operative if a suitable vent had been provided for the emission of air. He was assured that such had been done, but when he made the examination himself—as every wise and prudent man ought to do—he found that there was no vent at all for the air to pass through.

MR. R. O. PATTERSON (Blaydon-on-Tyne) said he did not agree with Mr. Young at all in the observations the latter had made with regard to the permeability of sand. He happened to be a user of a sand slinger, and when they got that machine about two years ago they had considerable difficulty with the moulds. From experience they had proved that a very coarse sand with a good percentage of bond gave the best results, and they never saw "scadd." They employed now a coarse sand which gave a very big aperture of space between the grains. Local experience—and it was that he was going upon—had proved to him and those associated with him in the work that the permeability of sand was a mighty big factor. Some time ago at his work they had a precisely similar experience in making railway chairs. In that instance the sand they used came from the Doncaster district. It was a coarse-grained sand with a good bond. They made these railway chairs regularly at his works, and with the perfect type of sand they were now working with they had never such a thing as a drawn chair to-day.

MR. J. S. GLEN PRIMROSE (Manchester) said that the author, on page 4 of his Paper, suggested sieves Nos. 6, 12, 20, 40, 70, 100, 140, 200 and 270 for the fineness tests. These figures, he would point out, referred to the American sieve series, and he did not consider they would convey any meaning whatever to those of their members who in this country used different measures altogether. American sieves were not stated or described in the Paper except by numbers. It was possible, he agreed, to establish some kind of co-relationship if anything to judge by or that was comparable with British sieves, could be obtained. There was, of course, a very fine microscope, and the use of that, he knew, raised an interesting problem. He was ready to admit that the microscope would be increasingly adopted in the laboratory with a view to finding not only the psychological constituents in each grade of sand, but also the relative grain sizes, and to establish points whether they were sharp, rounded or angular.

MR. A. RYDDERERCH, in replying to a few of the points raised in the discussion, said Mr. H. J. Young had rather confused him by jumping in at the deep end, particularly when he started by condemning high and low the question that was discussed in the Paper. He had heard Mr. Young aforetime, when discussing the chemical analysis of pig-iron, and then he was an enthusiast for control by analysis. Precisely the same argument applied to sand testing. There must be applied some essence of control in the elements that were to be used. The fact of the matter was that some sands were pronounced to be very good while others were reputed to be very bad. There were those amongst them who were prepared to argue that Manchester sand was the best possible, but on the other hand it was not difficult to find other people who solemnly declared that Manchester sand was no good whatever. The strange thing about it was that most of those who made these contradictory statements might be doing the same class of work. Wherein lay the difference? The argument he put forward was this, that they must have some method of controlling these things. Could they not apply correction or check methods? It seemed to him that if they were to condemn a thing before they started trying it they might as well shut shop altogether. They must be fair and take a reasonable and impartial view of things. Nobody knew better than Mr. Young that it was possible to go on experimenting for many long

years before positive results were got. Of course, it was the easiest thing in the world—and everybody realised that—to get negative results. Proceeding, the speaker argued that the laboratory test was not strictly comparable with what they got in actual foundry practice in the works. Tests in the laboratory were invariably carried out on a new set of conditions entirely, and to get a comparable laboratory test they must carry it out at very high pressure. The speaker proceeded to contend that he still considered it possible to test the permeability of varying grades of sand by using the tube method described in the Paper. Wherever there was a variation in grain he considered it was possible to detect and locate that. Personally he had been very much interested in the demonstration Mr. Fletcher had given on the blackboard. He had been rather struck with the remarks made by Mr. Primrose.

MR. J. S. GLEN PRIMROSE reminded the speaker that the point he had raised was for standardising sieve sizes and the adoption of a kind of uniform microscopical examination for determining the relative sizes and shapes of the sand grain.

MR. A. RYDDERERCH: Dr. Ries does not tell you what sands they are. The curves are simply there for illustration purposes.

Written Contribution.

MR. J. G. A. SKERL (Sheffield) wrote that it was very much to be regretted that Professor Ries had not been able to visit the conference to give his Paper in person, for he, and doubtless many others, would have welcomed the opportunity of discussing the progress of sand research methods and results at some considerable length, both outside and inside of the meeting room. With regard to the A.F.A. test methods themselves, the writer feels that detailed criticism of such pioneer work as has been done by the Joint Committee would be invidious and will confine himself to one or two general remarks, based on research work done with Professor P. G. H. Boswell and of late with the British Cast Iron Research Association.

Moulding sand research methods and tests should (1) be scientific and accurate; (2) be capable of reproducing foundry conditions and (3) yield results which allow of comparison between the various tests on the same sand. These ideals have not up to the present been attained in the laboratory, and all test methods must at the best be compromises, capable, however, of being correlated with results of foundry tests. Criticism must always consider this factor. From his own experience on sand research the writer would suggest that all tests be made to employ the same units. For example, the A.F.A. permeability and bond tests each contain a curious mixture of metric and English units, rendering mathematical treatment very tedious, as well as giving results which are apparently only empirical.

One of the greatest difficulties in sand research is to ensure the even ramming of test pieces, as, for example, in the permeability test. A moulding sand is a heterogeneous mixture of four states—solid, liquid, colloidal and gaseous, as represented in the sand grains, moisture content, the bond, and air in interstices. Each of these states behaves differently to physical forces, and each modifies the effect of these forces on the other states according to their proportion of the whole mass. For example, it is easier to ram a moist sand than a dry one. Since all sands have a different constitution, it is suggested that they each have an optimum pressure (ramming) value, and that the constant ramming devices as employed in the A.F.A. tests are of slight value and tend to mask actual facts, especially as the force employed in the permeability test is totally different from that in the bond test. Ramming is the most important factor to be controlled, and is, indeed, the basis of a moulder's art.

Finally, the writer would thank the author for a very lucid exposition of the American test methods and say how fitting it was that the A.F.A. had nominated to give this exchange Paper one who was a pioneer in sand research and who for upwards of twenty years had been seeking to advance the foundry trade of the world from his purely scientific Chair of Geology at Cornell. As a fellow geologist he again thanked him.

A NOTE UPON THE PRACTICE AND PURPOSE OF "PERLIT" IRON.

BY MR. H. J. YOUNG (NEWCASTLE-ON-TYNE).

THE PRESIDENT said they had listened to a most important Paper from their friend, Mr. Young, and it might happen that in future years this meeting in Glasgow might be regarded in the light of a memorable occasion indeed. Time was now limited, but he thought they could still spare opportunities for those of their number who were anxious to create some little interest in the engrossing subject Mr. Young had raised.

MR. J. SHAW (Sheffield) said that sometimes a few of the members did not always take Mr. Young's contributions at their full face-value, but on this occasion he felt they must all appreciate the importance of the Paper and the valuable information the author had placed before them. At the present time Mr. Young was doing a really good service to the Institute, and they must fully appreciate it. While he (Mr. Shaw) was in Germany in the course of last September, he gleaned some valuable data not only on the subject treated upon by Mr. Young but on the test-bar question as well. Mr. Shaw proceeded to describe two castings of perlit construction he had seen in Germany. He explained that he had sent a portion of the material to the Cast Iron Research Association and he had photographs which could be shown to anyone interested. His own feeling was they ought to recognise this preparation, even although it was a German thing, and to improve upon it if it was considered to be a feasible proposition for the industry.

MR. RYDDERERCH asked the author what he allowed for the permissible variation of the analysis. Then it would be interesting to know in relation to the temperature of the mould what variation the author allowed there. It struck him that some castings could be made with this process, but he rather feared the conditions would be impossible, or at least they would be found to be so, for many foundries. The point was, were they going to be impossible for every foundry?

MR. SHARP indicated that he had just returned from some interesting investigations into this matter in America. A great deal of work in the direction outlined in the Paper was now being done in America. The attitude now being adopted by the Americans was that all iron was under a perlitic condition and all they wanted to do was to fix it so that it could be realised and maintained in that condition. Personally, he had had evidence of foundries producing castings that went up to 24 to 27 tons tensile. In these foundries they had been doing that sort of thing for some years. They were pouring their castings out in cold moulds and producing material at or about the same cost as ordinary grade iron. The American, by keeping a very careful control over chemical analysis, was converting his foundry into a laboratory more than we in this country could ever hope to do. In America they were approaching this question from the flat rate of production, and they were looking to the treatment of the metal to ensure that, in the main, it was dealt with in accordance with ordinary foundry practice and conditions. He was not putting forward these arguments by way of rushing people in this country into a realisation of the possibilities or otherwise of perlitic iron, but simply to testify to the fact as the outcome of personal investigation that perlitic iron in a commercial way was being produced in America at the present time.

MR. J. S. GLEN PRIMROSE said he would like to know what Mr. Young meant by discarding his own language and making use of the term "perlit iron." Was it not quite sufficient to refer to this as pearlitic iron? Perhaps Mr. Young did feel a little on this point, but, even so, he ought to tell them why he discarded the English word "pearlitic." Then there was one sentence in the Paper which to his mind was not very comprehensible. It ran thus: "Also is it recognised broadly that grey iron containing the maximum amount possible of combined carbon, without free cementite, is the best form in which any one particular cast iron can be—this form being described as all-pearlitic." It seemed to him that Mr. Young had got to explain to them what he meant by the use of the word "maximum" there. Then at the foot of page 2 the

author said: "In other words, these voids should be short, thin, curly or nodular and confined within the network." He would really like to know what "network" was referred to in that sentence. Again, on page 11, the author observed: "The matrix will be at its best in all sections, and the grain-size will be more uniform and favourable." The question he would put here was, "more uniform and favourable" for what? Towards the close of the Paper Mr. Young was responsible for this statement:—"Therefore, the superior voids found in perlit iron, as compared with those in grey iron cast in cold moulds, may be due to the hot mould not causing the precipitation of these gases at the same period or to the same degree." Personally, he (Mr. Primrose) had never seen a precipitation of these gases. He supposed the author was rather asking them to believe it was an alteration and not a precipitation of the gases.

The Author's Reply.

MR. H. J. YOUNG, in replying to the discussion, remarked that he did not think it was necessary for him to answer the points raised by Mr. Marks. Other people had already done so, and particularly those who claimed to have made perlit iron as distinct from pearlitic iron. He still repeated, however, that it had never been substantiated that anyone had made perlit iron seriously and with the same measure of control as was mentioned in the specification which accompanied his Paper. In reply to Mr. Shaw, he had to acknowledge that he had seen one of the castings made by the people he referred to in the course of his remarks. There was no doubt these people had been set a very hard task, and one to which they were entirely unaccustomed. He (the author) personally appreciated the huge difficulty that was involved in turning out that iron. The transference from cold moulds to hot moulds was an operation that required a great deal of research work. Undoubtedly, so far as the experiments had gone, it demonstrated that the process applied equally successfully to heavy castings as to light. It was all a matter of applying the operation properly. It could be done, too, for their castings. The casting on the whole was undoubtedly better, and they got the perlit structure as distinct from the pearlitic structure in this country. A question had been asked whether the mould must be warm in order to get perlit iron. His reply to that was candidly in the affirmative. Of course, everybody in this country knew all about pearlitic iron. As a matter of fact, he had been engaged in the manufacture of that since ever he started work. On the other hand, he had been making perlit iron during the past few weeks, and he was bound to say, speaking from practical knowledge and actual experience, that the manufacture of pearlitic iron had nothing whatever to do with the former process. The question had also been asked whether it was necessary to have some control over the analysis of the iron and of the heat of the casting. Personally, he felt that was an unnecessary query in the year 1925. The firm that was not following the principle of metal control at the present stage was not moving abreast of the times. For high-class work—such as Diesel engines—they must have that principle in operation, and the firm who was not doing it, or was unwilling to do it, must not condemn the practice. He was interested in what Mr. Sharp had said about his American experience, but it was common knowledge that they had heard a lot about the things that America could produce and manufacture. In his own Paper he had gone about actual practical experience and from what he had seen he was bound to say that if indifferent iron was used the process would make that iron better. Not only so, but if the iron was good that iron would be rendered better by the process. This was what might be described as a production of one big property; rather was it the production of many properties. Indeed, he made it perfectly plain in the second paragraph of his Paper that the moulds were heated to a pre-determined temperature to suit the metal with which they were to be filled, while, on the other hand, the metal was controlled to a pre-determined composition to suit the average thickness and the mass of the cutting it had to occupy. He did not know that the word "perlit" was an alien word, or even that it was a German word. As a matter of fact, he believed he had been largely responsible himself for calling this "perlit" iron in Great Britain. His reason for introducing the word was to get away from the idea that this had anything to do with pearlitic iron. His own idea had been that it would be useful to call this "perlit" iron as distinct from pearlitic. Accordingly, no matter what Mr. Primrose might say to the contrary, he dissociated himself from any desire to introduce a foreign word. It did not seem to him that the other points raised by Mr. Primrose as to the "network" and the use of the term "precipitation" were of much importance to the particular issue that was being discussed.

Written Contribution.

Mr. J. E. Hurst writes:—As my own Paper has been largely quoted by Mr. Young I feel called upon to contribute to the discussion on this subject of Pearlitic Cast Iron. I have already publicly stated in so many words that I have no doubt whatever that if the pearlitic process and material does comply with the definition and claims made for it, then it can be truly described as an important invention and a distinct step forward in foundry practice.

The fundamental features underlying the process and the improvements arising therefrom have been very clearly stated by myself from a study of published information and by Mr. Young from actual experience of the process.

Confining our attention to the two most outstanding points as follows:—(1) The fundamental feature that the cast iron must be when cast normally into ordinary sand moulds; and (2) the fact that when cast "Perlitically," this iron is grey and has a uniform grain size across the section of the casting regardless of its thickness.

These two features have been the aim and object of all thinking ironfoundry metallurgists for many years, and I am sure that, like myself, they will be unable to accept the statement unaccompanied by evidence that this is accomplished by the pearlitic process.

I had expected to find this evidence in Mr. Young's Paper, as I have no doubt that he must have satisfied himself on these points. The fact that this evidence has not yet been given prompts me to suggest in detail the evidence I would like, and I am sure all foundrymen would like, to enable them to evaluate the pearlitic process:—(1) The chemical analyses of two bars which might be designated A and B, together with photographs of the fractures of the bars. These bars should preferably be cylindrical and not less than 1½ in. dia. They should be cast from the same ladle A to be cast by the "Pearlitic Method," and B to be cast in either an ordinary green or dry sand mould, and (2) micro-photographs taken at several points from the outside edge to the centre of the pearlitic bar A would at once demonstrate the uniformity of the structure which is stated to be secured. Two series of photographs at these points, the one showing the graphite size and the other the network size would demonstrate this very clearly. The point could be still more strikingly demonstrated on a thicker bar, say, 6 in. dia.

This evidence would clearly demonstrate that pearlitic cast iron is actually white when cast in the ordinary way and has a uniform grain size when cast in the pearlitic way. These are the two fundamental features claimed for the process, and seem to me to be worthy of full and ample demonstration.

Finally, I am sure that such full and ample demonstration cannot fail to be of value both to the inventors, licensees, and to the process itself.

Foundry Query.

Metal Suitable to Stand Red Heat.

We supply a considerable number of castings for use in furnaces, and find that there is great difficulty due to the gradual growth of these castings under the continual temperature of 800 to 850 deg. F. to which they are subjected.

As a typical case, the sleeve containing a pyrometer of about 5 in. dia. and 18 in. in length will grow from 10 per cent. to 20 per cent. both in length and diameter in the course of a few months, a red deposit of iron oxide collecting on the surface. We are anxious to reduce this growth as much as possible, and should be glad of any advice on the question of the best mixture to use.—C. N.

Britain's Largest Malleable Iron Foundry.

Size alone is not usually a feature which unduly impresses the British engineer, but when associated with brilliant organisation and studied care of quality, as is the case with the Leys Malleable Foundries at Derby, he is whole-hearted in his admiration. Our representative was recently afforded an opportunity of inspecting both the plant and organisation, and noted with pleasure that the works were fully employed, new plant was being installed, and extensions were in contemplation. The works, which are situated at the side of the old Midland Railway main line, were commenced 51 years ago by the late Sir Francis Ley,

FIG. 2.—STOCKYARD AND REFUSE CONVEYOR. LEY'S MALLEABLE CASTINGS COMPANY, LIMITED.

Bart. They cover an area of 30 acres, and ample space is available for extensions. With the exception of a bay devoted to grey cast iron for domestic consumption, the whole of the output is blackheart malleable cast iron.

A general plan of the foundry part of the works is shown in Fig. 1. In addition to this, there are several large shops devoted to the manufacture of chain drives, elevators and conveyors.

The stock yard, shown in Fig. 2, shows on the left the method employed for dealing with the works rubbish. Large stocks of iron are carried as, for the successful production of high-class "black-heart" castings, the firm uses some thousands of tons of machine-cast American pig-iron. It is not from choice that recourse is made to this iron, as it has been found by long experience in the use of all classes of irons, British and otherwise, that it is necessary to use a percentage of American material. Thus a premium is paid initially to ensure quality.

Chemical and Physical Control.

The chemical control, which starts with the raw material, is continued throughout the whole of the manufacturing stages. There are both chemical and physical laboratories, the former being furnished with all the necessary appliances for both routine and research analysis work. Every cast is analysed for carbon, silicon, manganese, sulphur and phosphorus, and the results are not merely entered up, but are plotted against the log of each air furnace. Thus the merits and demerits of each furnace and its melter is at once apparent. This collating of results with data of repairs, fuel consumption, pressure and volume of wind, charging, slagging and other melting operations, has been found to be an essential for the successful after treatment of the castings during the annealing process. The methods of control of the melting practice enable any disturbing factor to be readily diagnosed and rectified before any serious change in composition has resulted. On the physical side, a 30-ton Avery universal tester and a Humphrey autographic notch bar tester are in constant use. The metallographic laboratory is provided with a Watson microscope and the usual photographic apparatus. Obviously, in a foundry of this character, with its battery of annealing ovens, pyrometric control is essential, and Leeds-Northrop and Siemens installations take charge of all twenty-four annealing furnaces, simultaneously recording the thermal history of each.

Test bars from each heat bear (1) the identification letter of the furnace, (2) the day's cast-number, and (3) the date. Thus B—2—4/3 would indicate that the test bar related to that made on March 4 from the second cast made by furnace B. These bars are annealed in various parts of the furnace, and are submitted to tensile (on 3-in. lengths), torsion and bending tests.

The average ultimate tensile strength is 23½ tons per sq. in. associated with 14 per cent. elongation on 3 in.

The Pattern Shop.

As most malleable castings are small, nothing spectacular would be expected from the pattern shop, but, as will be seen from Fig. 4, it is definitely well equipped, well lighted and ventilated, and the machinery suitably guarded. It is replete with band saws, sand-papering machines, and

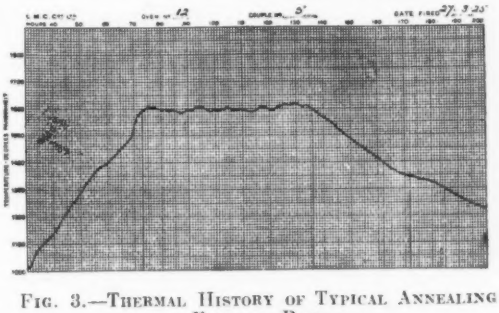


FIG. 3.—THERMAL HISTORY OF TYPICAL ANNEALING FURNACE RUN.

planers by Sagar and other well-known makers, whilst dovetailing and grooving machines are "home made."

Metal Patternmaking.

As practically all malleable castings are repetition jobs, the metal-pattern department in a works of this character assumes important proportions. A general view is shown in Fig. 5. The metal is provided by two coke-fired pit furnaces, and the equipment includes five lathes, three drilling machines, two vertical millers, and engraving, planing, slot-drilling, and wibbling

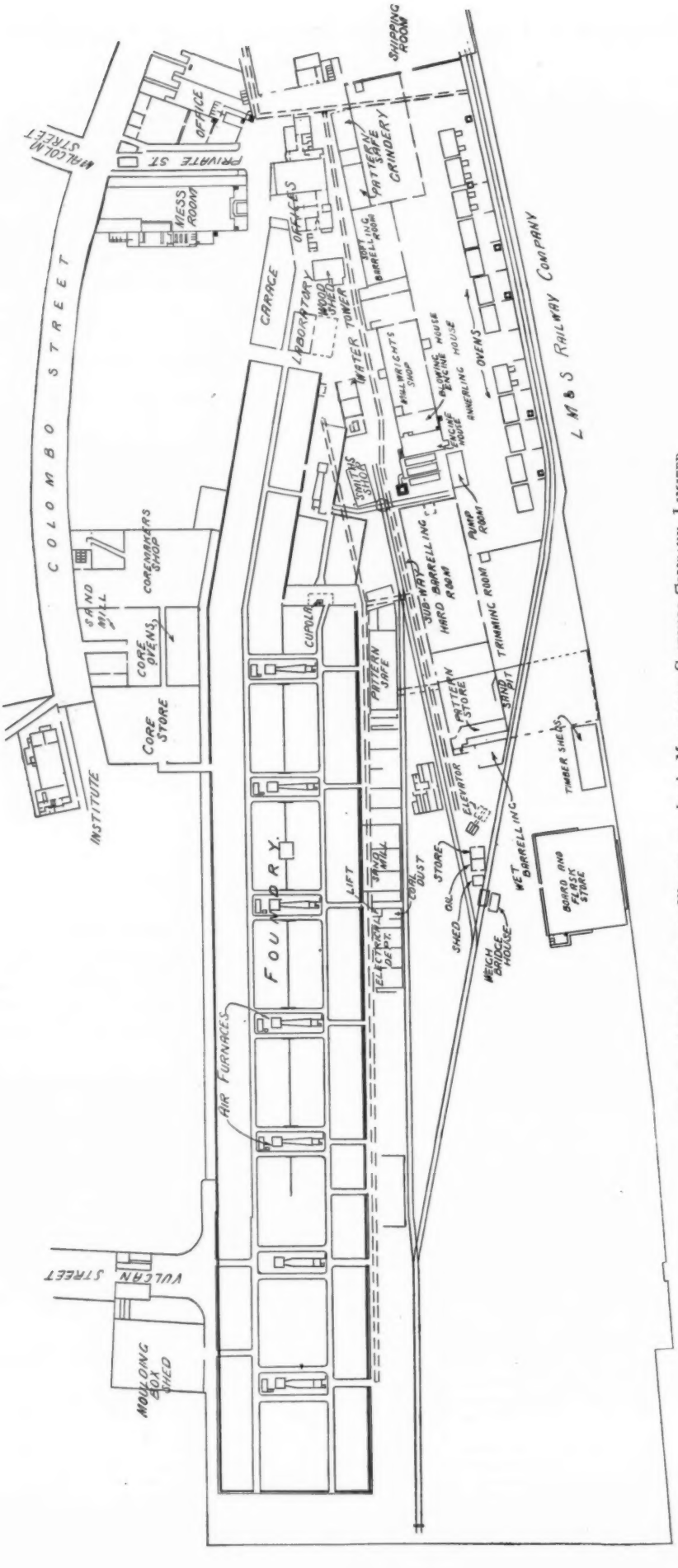


FIG. 1.—LAY-OUT OF THE WORKS OF LEY'S MALLEABLE CASTINGS COMPANY, LIMITED.

machines. A large number of moulding machines are used in the foundry, and four of these are shown in the centre gangway, being fitted with metal pattern plates.

FIG. 4.—THE PATTERN SHOP.

Pattern Storage and Organisation of Work.

The pattern safe is responsible for the organisation and issue of all orders and patterns to the foundry, and all patterns produced in the works or sent in by customers are passed through this shop. Here the various jobs are indexed and labelled, there being some thousands of jobs in works at any period.

from oil and sand. Normally an emulsified mixture of linseed and molasses is used but for certain jobs, which would be difficult to handle in the green state, Glyso is employed. The sea sand is not normally dried, but should the moisture content become too high, it is charged on to the sloping roof of the core-drying stove, and as with the dryness the fluidity is increased, it automatically drops into barrows ready for conveying to the mixer. This is a simple contrivance, semi-circular in shape, provided with revolving paddles and a self-emptying device. For transporting the cores in the green state, a large number of trays or driers are available. These are either of cast iron or blocks of baked core, with depressions corresponding to the shape of the cores to be carried.

FIG. 5.—METAL PATTERN SHOP.

Core-making Shops.

The core making is carried out in three adjoining shops, shown in Fig. 1, one of which being illustrated in Fig. 6. A large number of cores are made by female labour

We regret our inability to obtain a picture of the continuous core-drying stove, but it is housed along the wall of the three shops. It is over 100 ft. long, and carries a double line of two-deck bogie wagons. It is town's gas fired, and is pyrometrically controlled at 230 deg. C. The cars are moved by a horizontal air hoist provided with a finger fixed horizontally at right angles to the piston and turnable through a half-circle. This on its outward motion pulls the chain of cars out of the furnace to exactly the length of one car, whilst its inward stroke pushes a second chain of trucks inwards. An outstanding advantage is the simplicity of construction combined with facility of handling large quantities of cores of all sizes with the greatest of ease. If, for instance, a truck contains a load of large cores which are insufficiently cooked, they are merely, after arrival at the mouth of the furnace, sent to the "terminus" of track and the "points" changed over and sent through the furnace a second time. This furnace has been designed by the works manager and constructed in the works.

FIG. 6.—THE CORE SHOP.

The Casting Shop.

There are but few foundries in Great Britain, and certainly no malleable shop, which cover such an enormous area as does the Leys concern. The foundry is approaching a quarter of a mile in length and covers an area of about five acres. Thus an all-embracing photograph is impossible. However, Figs. 7 and 8 convey some idea of both

FIG. 7.—ONE OF THE CASTING BAYS.

the size and the excellent lighting. The system employed is to allot a fixed floor area varying from 250 to 350 sq. ft. No fewer than 700 men and boys are employed under the one roof, yet there is no evidence of overcrowding or untidiness. The gangways are kept quite clear. This is an essential, as a number of power-driven trucks are utilised for transporting the raw materials. In fact, the bulk of the transport is carried out by this means, though it is supplemented here and there by a monorail system and a 2-ton Morris travelling and six hand-operated overhead cranes. Pneumatic pressure is everywhere available for replacing bellows, connecting moulding machines, fixing to portable drying stoves, etc.

Practically speaking, the whole of the moulding is green sand, with oil sand cores, but a few jobs are skin-dried, whilst an inconsiderable number require thoroughly drying, and for this purpose an Oehm heating element has been installed.

FIG. 8.—SHOWING THE SYSTEM OF ALLOTTING A CERTAIN AMOUNT OF FLOOR SPACE TO EACH MOULDER.

White iron requires more care in the matter of gating and running than does grey iron, but in common with this and all other alloys it is liable to suffer from non-metallic inclusions. The Leys Malleable Foundry take no risk in this direction, and filter grates or strainer cores are used in connection with paper or other covers, so as to ensure a head of metal before entering the core. There are at the disposal of the moulders no less than 200 moulding machines, including several Britannias, but the majority are an American make (B. & B.), constructed under licence in their own shops.

FIG. 9.—THE HARD BARRELLING SHOP.

Melting Plant.

In the malleable shop there are six 10-ton and two 20-ton air furnaces of the normal American type, such as has been described and illustrated by Touceda in a Paper presented to the Institute of British Foundrymen. It will be remembered that the roof consists of series of independent "bungs" or cast-iron arches containing firebrick. These are removable for charging purposes. A melt takes about 3¼ hours, and the coal consumption is 2½ tons of metal to 1 ton of fuel.

Cleaning the Hard Castings.

Both sand blasting and barrelling are used for the cleaning of the hard castings. The barrels are run "dry," but being totally enclosed, there is no real dust trouble. There are sixteen installed, and vary in length from 4 to 6 ft. and from 2 ft. 6 in. to 3 ft. 6 in. in diameter. They are of a wood and cast-iron composite construction, as is clearly shown in Fig. 9. There are totally enclosed sand blast chambers by Tilghman. These are operated at 90 lbs. per sq. in. pressure with steel shot. After sorting and a

FIG. 10.—A VIEW OF THE FRONT OF THE ANNEALING FURNACES. THERE ARE 24 FURNACES IN THIS SHOP.

FIG. 11.—THE GRINDERY SHOP. EACH MACHINE IS PROVIDED WITH AN EXHAUST.

rigid inspection the castings are passed into the annealing department.

Annealing Process.

There are 24 coal-fired annealing furnaces, each containing 24 stacks of boxes. These latter are placed on stools, so designed that the fingers of the charging machine arm can quickly handle the stacks. The general appearance of the front of the ovens is shown in Fig. 10, which shows a number of stacks of annealing boxes in the foreground.

The actual annealing takes about 12½ days. In recording the thermal history, the pyrometer ends are actually inside the annealing pots. After about 550 deg. C. has been reached a continuous record is taken, which is plainly visible to the furnaceman. Such a chart is reproduced in Fig. 3, taken from an actual record at random. From this it will be noticed that the charge is kept at about the Ar1 point (actually 870 deg. C.) for 63 hours. It actually took 73 hours to reach this temperature. For the cooling 10 hours were absorbed to lower the temperature from 760 to 730 deg. C. and 13 hours from the latter. The boxes last from 8 to 10 heats. From each run two tensile (0.65 dia. × 3 in. gauge length), three wedge and two torsion or bending tests are taken, and the results are carefully recorded.

Subsequent Operations.

After annealing, the castings are again barrelled where necessary. This is carried out in a shop quite separated from "hard barrelling," as is indicated in Fig. 1. Most of castings require a certain amount of grinding to remove traces of "fins" and unevennesses resulting from the runners and risers. This is carried out in a shop 150 ft. long by 60 ft. wide. A portion of this is shown in Fig. 11. The shop is well lighted and exceptionally well ventilated. Each machine is properly exhausted into duct leading to the dust collecting apparatus.

It is too much to expect that every casting, especially the larger ones, will not warp slightly during annealing. The Leys Foundry Company have anticipated this, and succeeded in meeting all objections by installing three hydraulic presses, which ensure for the castings the correct contour and a certainty of the elimination of trouble when jig-machining.

Compressed Air Plant.

It will be readily recognised that in a foundry of this character there is an enormous consumption of compressed air. For general foundry use it is delivered at 100 lbs. pressure. For this purpose two Sentinel compressors have been installed, one, which delivers 700 cub. ft. per min., is driven by 150-h.p. Newton motor, whilst the other, delivering 400 cub. ft. per min. is steam-driven. In addition, there are a steam-driven Browett-Lindley delivering 2,400 cub. ft. per min. and a Tilghman giving 1,500 cub. ft., the latter being driven by 120-h.p. Westinghouse motor.

The Grey Iron Foundry.

The grey iron foundry is purely for the production of castings for consumption in their own shops. A 3½-ton per hour cupola, 44 in. inside diameter, and driven by blast entering through four tuyeres, is used for melting the metal.

General Consideration of the Product.

Mechanical Tests.—The average tensile test to be associated with the Company's black-heart malleable is from 22 to 26 tons per sq. in. maximum stress taken on a 0.66-in. dia. bar. With this is to be associated a 15 to 17 tons per sq. in. yield point and an elongation of from 10 to 18 per cent. on a 3-in. gauge length. A 1 in. × ⅝ in. bar can be relied upon to bend cold round a 1-in. dia. to 180 degs. without fracture. The material is particularly strong in torsion, a bar chosen by our representative went the full 360 deg. without fracture.

Machinability.—Few better tests of the machinability of black-heart malleable could be shown to improve upon that returned by a firm using this material for radiator nipples. They have reported that 39,000 of these tiny castings have been automatically machined without regrinding the tool.

Trade Talk.

SHAW, WARDLOW & COMPANY, LIMITED, have removed to their new offices at Shawdlaw House, 38, Grosvenor Place, S.W.1.

THE MANNESSMAIN WORKS at Landore, Swansea, have been idle this week while new plant is installed. Part of the work was done last week.

A £15,000 ORDER for electric cable is stated to have been awarded by the Ilford Urban District Council to the German Cable Works of Berlin.

J. P. STURGE & SONS have sold by auction a quantity of lattice girders, W.I. sheets, W.I. bars, stanchions, etc., at the Clevedon Gas Works.

THE TRAMWAYS COMMITTEE of Glasgow Corporation has agreed to recommend for acceptance the offer of the Steel Company of Scotland, Limited, for the supply of steel tyres required by the tramways department.

THE AILSA SHIPBUILDING COMPANY, LIMITED, of Troon and Ayr, have obtained from the Isles of Scilly Steamship Company, Limited, an order for a fast steamer. The vessel and machinery will be constructed at the firm's Troon works.

MR. C. GARFIELD RICHARDS has resigned his position as secretary of the Welsh Artizans United Association, and has been succeeded by Mr. R. G. Lewis, of Morriston. In future the offices of the Association will be at 55, Morfydd Street, Morriston, Swansea.

WITH A VIEW of effecting economies considerable alterations are being made at the Grovesend Steel & Tinplate Company's works at Gorseinon. Two of the furnaces are being dismantled, and are to be replaced by more modern furnaces. The steel bar mill is also to be re-equipped.

DURING THE MONTH of May eight vessels of 18,325 gross tons were launched from Tyne shipyards, against seven of 27,432 tons for the same month in 1924. This year's launchings up to the end of May therefore total 26 vessels of 87,194 tons, compared with 29 of 111,119 tons for the first five months last year.

THE DEBENTURE HOLDERS of Richardson, Duck & Company, Limited, Stockton-on-Tees, at a meeting held last week, decided that the best interests of the concern would be served by closing down the shipbuilding business for the present. This decision was reached after a statement had been made by Sir Arthur Whinney, the receiver. The company, of which Mr. J. C. Gould has been chairman, was registered in July, 1919, with an authorised capital of £375,000, the controlling interest being held by the Gould Steamships Industrials, Limited. There are also first mortgage debentures amounting to £250,000

THE AUSTRALIAN PRIME MINISTER has made available the British and Australian tenders for building the cruisers, but without the names of the English tenderers. There were ten English tenders, all being very close. The lowest for one complete ship was £2,011,812, and for two ships, each £2,001,327, one for delivery in 34 months. The tender accepted, that of J. Brown & Company, Limited, for delivery in 36 months, was a little higher, but the cost of coal would be smaller. This tender for one ship was £2,028,552, and for two ships, each £2,007,401. The highest tender was £2,186,331 for one complete ship. It will cost £50,000 to lay a ship out, and £140,186 for spare guns for two ships whenever built. The Australian tenders for a complete ship were: British ship builder, £3,238,694; Cockatoo, Australian machinery £2,879,920, British machinery £2,811,291; Walsh Island, British machinery £3,137,453. The tender of John Brown & Company is £12,208 higher for the two vessels than the lowest tender. This sum will, however, be saved in 18 months in coal consumption under peace conditions, and the saving will be continuous at the same rate while the vessels are in commission. If the second vessel were built in Australia it would cost the taxpayers an additional £818,000. This is the difference in cost between the lowest British and Australian tenders. The comparative figures are:—Lowest Australian price for one completed vessel (Cockatoo Island), £2,879,920; lowest British price for one completed vessel, plus £50,000 for bringing her out, £2,061,812. The actual cost to the Commonwealth, including every item of expenditure, of the two vessels ordered from John Brown & Company, will be £4,253,861. This amount is made up as follows:—Two vessels in accordance with tender received, £4,014,862; cost of bringing out two vessels from Great Britain to Australia, £100,000; spare parts for two vessels not carried on the ship, £140,000; total, £4,254,862. To build one of the cruisers at the yards of John Brown & Company, and one at Cockatoo, would involve a cost of: One vessel at Cockatoo, £2,879,920; one at Brown's, £2,028,522; cost of bringing one vessel to Australia, £50,000; spare parts for two vessels not carried in ships, £140,000; total, £5,098,442. The saving effected by the course adopted by the Government will thus be £843,580.

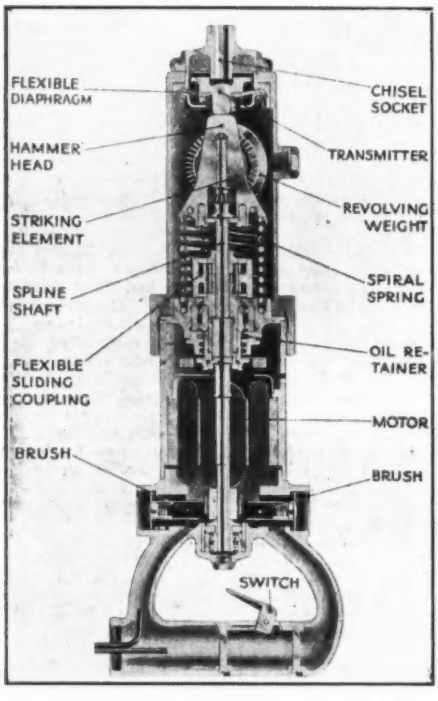
The Kango Hammer.

Our representative recently had the opportunity of inspecting this tool at a press demonstration held at 78, Petty France, London, S.W.1, by the Kango Company, Limited, who have modified the original design. The machine is constructed in Coventry of all-British material.

Professor Goldschmidt's invention, upon which the Kango hammer works, utilises centrifugal force for the conversion of rotary into reciprocating and progressive motion, and amounts to the discovery of a new mechanical principle.

Although several attempts have already been made to utilise electrically-driven percussion tools of this nature, the effectiveness of their blows so far obtained for the weight of the machines has not yet justified their commercial utilisation. The principle adopted on these has been either magnetic by use of solenoids or that of an electrically-driven crank or cam blow, neither of which can give the progressive intensity of blow obtained by the Kango.

In the Kango hammer the reciprocating and progressive effect, which amounts to a definite blow, is obtained by the rotation of two heavily loaded bevelled gear wheels placed facing each other and driven through the same bevel pinion in opposite rotational direction.



DIAGRAMMATICAL CROSS SECTION OF THE KANGO HAMMER.

The weights of the loaded gears are in this way brought into juxtaposition at two points in their path of rotation per revolution, converting their centrifugal force into a sharp oscillating motion forming the blow which is conveyed to the chisel or tool through a transmitter held in position by an oil-retaining leather diaphragm, the recoil is taken by a spiral spring which serves to kill vibration and adds impetus to the blow on the tool.

The drive from the motor shaft to the spline shaft, of which the bevel pinion is an integral part, is taken through a special form of centrifugal coupling which obviates any twisting of the spline shaft being conveyed to that of the motor.

This coupling consists of a square box on an extension of the armature shaft, two weighted links which fit in slots in the periphery of same, and are in turn connected by two pins to the driving piece with internal splines which is a free fit on the spline shaft.

When the hammer is at rest the external points of the links are at the inside extremities of the slots and at an acute angle with the driving piece, but as the speed rises they fly out in alignment with the driving piece, responding instantly to any retardation of the spline shaft, leaving the internally splined driving piece absolutely free on the spline shaft so that it can move up and down freely without friction.

The parts referred to comprise the mechanical element of the hammer encased in the tool-end section of the casing, which forms an oil bath and which is joined to the electrical unit casing by the large external collar which it is only necessary to unscrew with the special key provided to gain access to the whole of the mechanical parts. Between the mechanical unit and the motor there is an oil-tight joint which separates the ball races of the motor and the oil bath from the motor itself. The motor, which is universally wound for either 110, 200 or 220 voltages, is encased separately with its brushes at the end nearest the stirrup handle and switch, the whole being ventilated by a special fan.

The motor speed, which is in the vicinity of 9,000 to 10,000 r.p.m., is reduced at the bevel gearing in the ratio of 3 to 1, and as a practical indication of the low current consumption required, it will be sufficient to state that that of the 220-volt hammer is approximately 1.4 amps. The most interesting point of this new principle is the part played by the speed of rotation of the weights and the effect on the oscillating motion at the hammer head. Variation of speed produces a harmonical variation in the number of blows, and as the speed is increased, blows of proportionately increased intensity to those obtained at one blow per revolution can be obtained.

As the oscillating effect of the hammer head produces essentially a floating blow, the Kango hammer has the great advantage of being proof against overloading. This principle is covered by a patent which constitutes a master-patent over many other applications of which it is capable, and has first been applied to practical commercial use on the light mechanical percussion tool, which in itself opens up an extensive field of use sufficiently important to justify concentration on its development.

So far it has only been possible to use pneumatic tools for this type of work because there has been no other means sufficiently developed for practical commercial use. The low efficiency of the pneumatic system, however, has always proved a serious disadvantage in its use, and this, together with the cost of compressor plant installations, as well as their upkeep, has limited the use of percussion tools to cases where only their extensive use has counterbalanced the deficiencies of the system sufficiently to render it of practical use.

The size of the larger centralised pneumatic plant, with its limited radius and increased inefficiency as this radius increases, together with the still greater inefficiency of the multiple set or smaller semi-portable units, have all contributed to the importability of the pneumatic system and have unnecessarily limited its use.

At the demonstration the "hammer" was first applied to the cutting of wood. Its speed of working is not far removed from that of a band saw, especially when the time of setting up is considered, whilst the surface given is similar to that left by planing. Next the chiselling of the edge of a ½-in. mild steel plate was shown, followed by a demonstration of drilling holes in brickwork, York stone and marble. In this case a tommy bar is attached to the chisel, and hand rotation of the tool both quickly and efficiently produces a workman-like hole. Actually on marble a 2-in. hole was drilled in 60 secs. Unfortunately, no castings as received from the sand were available for demonstration, but our representative has arranged for a foundry demonstration, when the tool will be given work in the patternshop, the fitting shop, as well as such jobs as cupola cleaning and brick dressing. In the last application there appears to us to be a large field for easing the work of the bricklayers in preparing shapes of silicas, magnesites, chromites and other dense bricks. A demonstration van has been provided, so that the foundries will have the advantage of examining the efficiency of the tool under working conditions.

Design of the Modern Foundry.*

By Frank D. Chase.

The manufacturer who manufactures his own castings must either make them better and cheaper than he can buy them, or give this cost advantage to his competitor, and the jobbing foundryman must cut his costs or lose his business.

If the foundry is not designed to meet this situation it should be rebuilt, remodelled or rehabilitated to do so. This is usually not a difficult task—the need of the foundry industry to-day is not more foundries, but better foundries.

There is ample capacity in existing plants, in most sections of the country to produce the tonnage of castings for which there is a market, but usually a large percentage of this capacity cannot be operated at a profit, due to high production costs. Production costs are dependent on the two factors of labour and materials. The costs of materials will not be discussed. The cost of labour in a foundry is the item which must be reduced and usually can be reduced.

For every pound of finished castings produced, over one hundred pounds of material of some sort are lifted or moved or hauled once. This simple statement often questioned, and easily proved to one's own satisfaction indicates the opportunity for cutting labour costs.

There are many manufacturing plants in operation to-day and many foundries which could profitably be scrapped in their entirety and many more which are susceptible of great improvement, *i.e.*, great reduction in operating costs by means of reducing handling costs. The beginning of a new plant or the rehabilitation of an old one calls for a comprehensive analysis of the entire problem, and all of the essential factors must be checked off the list of considerations. These are briefly tabulated and commented upon as follow :—

(*a*) Raw materials—cost, supply; (*b*) transportation, raw materials, finished product; (*c*) fuel, water, sewage, power; (*d*) labour—quantity, quality; and (*e*) market.

These seem self-evident, but to-day plants are being put down without a real study being made of all of these items.

Plant Site.

The choice of a site depends upon (*a*) railway and trucking facilities; (*b*) material, raw and finished, storage; (*c*) labour, transportation, housing, supply; (*d*) area for present and future needs; and (*e*) water, light, power, sewage.

Again these seem obvious, but a brief analysis of ten or a hundred plants will develop a failure to consider one or more of these essentials. The writer can cite hundreds of examples of plants, old and new, which are improperly located. Too often the engineer is called in to design the plant after the property is bought rather than before—one can hardly expect the designer to analyse these technical or manufacturing problems, and few manufacturers or foundrymen have a staff competent to do it, so it is not done, until too late, and the engineer has to develop an unsuitable site in the best manner possible.

Probably the most common error of plant location is the failure to anticipate future growth, either in the size of the property and its location with reference to surrounding growth or in the layout and arrangement of buildings which will permit of proper expansion.

Given the property, the development of the plant is logically as follows: (1) Layout; (2) design; (3) construction; and (4) equipment of the building or buildings.

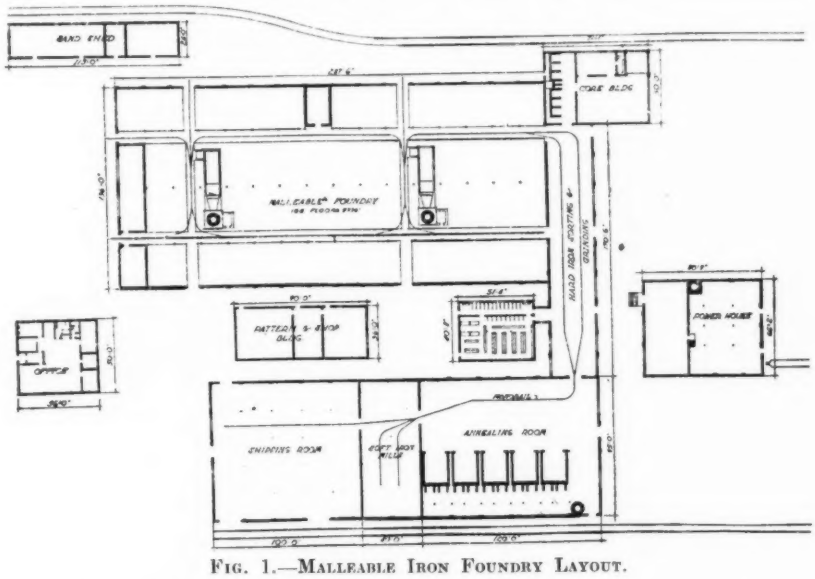


FIG. 1.—MALLEABLE IRON FOUNDRY LAYOUT.

Layout.

The first consideration in the process of making castings, whether they be grey iron, malleable or steel, requires a straight line and short line process from start to finish. This principle applies of course to all manufacturing operations.

There must be no back-tracking from the material storage yard to the shipping room, the shortest and most direct line of operations must be developed. The proper layout securing this result conserves time, labour, floor area and thereby reduces costs.

Fig. 1 shows a layout of a malleable iron foundry and indicates the above-mentioned points. This layout has proved so satisfactory that five plants have been designed by the writer, essentially as shown and in different parts of America.

The flow of materials is easily traced from the material yard to the melting furnaces—to the moulding floors—to the hard iron room—to the annealing department—to the soft iron, and then to shipping. Expansion can be and has been secured by extending the moulding area on the opposite side of the hard castings room, widening the latter, and increasing the length of the annealing and other departments and storage space.

Fig. 2 shows a modern grey-iron foundry making boiler castings. The raw materials are hauled to the charging floor—direct from the truck or bins—core sand and cores move with minimum labour to the points of use—moulding sand is hauled by crane to bins, to moulding machines, to flasks,

* Extracted from "The American Metal Market," April 14, 1925.

shaken out, tempered on the floor and back to the bins by crane grab bucket. Flasks are hauled, closed, shaken out and placed by crane, and castings go by the same crane to cleaning and thence by monorail to the assembly shop adjacent.

These illustrations are typical of the modern foundry.

Other items suggest themselves, *i.e.*, flask and pattern handling and storage, core making, cleaning, testing, etc.—all steps which should fit into the straight line of operations, thus reducing time, labour and floor space.

The advantages of time and labour are obvious, but the savings in capital investment in new plants, and in securing increased production in old plants with reduced costs by the proper layout, has not received the consideration it deserves. The "Foundry That Fits" often results in saving in floor area, secured by a proper departmental area of from ten to a hundred per cent. This means a great deal in these days of high building costs.

Many an old plant can be rehabilitated, and should be, to secure needed increase in production, rather than to build more buildings. The second consideration of plant layout is the designing of proper equipment to eliminate or reduce labour costs. The building is the big machine which houses the little machines. Hence the whole layout must be developed as a unit—taking into consideration each operation. The modern tendency is to over-equip. It is a temptation to put in conveyors for this and that and the other thing. It sounds good while the salesman is talking, but upkeep and savings should be carefully figured before the investment is made.

There are many ways of equipping to reduce and eliminate labour costs—each one of which has its advantages and disadvantages. The correct method can be determined upon, if a broad and intelligent analysis is made by an unprejudiced and competent person, of all methods. The crane, in all its types and kinds, is used throughout the modern foundry and haulage by other than man power, coupled with gravity which as a motive power costs nothing, offers attractive savings.

The storage of raw materials is the first step in most foundries. For a covered grey-iron foundry yard a magnet and grab bucket on a 70-ft. bridge crane, and an elevated track with bins underneath, eliminate almost entirely man power.

For a large outdoor storage yard electric or other motive power tractors should be employed more often. Sand, castings, flasks, patterns, sprues and gates, cores, and in fact practically everything moved in the average foundry can be handled in this manner. By building ramps, most unloading becomes a dumping operation—eliminating time and labour. Monorails and jib cranes provide for long hauls and short spans for any required capacity.

The proper combination of these above-mentioned methods makes for a low cost foundry, but these cannot always be secured in a building unless the problem of material handling is considered as a whole to make a successful unit.

The third consideration of layout is the proper provision not only for the satisfactory handling of the requirements of the present business, but of the future. Every department should be so situated that expansion may be made as needed and without interfering with other departments. It is not easy, in fact is seldom possible, accurately to plan for the future, but the record of a company's past, the personnel which gives the promise of the future, the trend of development of the product and the industry all have a bearing on what any plant may be called upon to produce and should be given thought. No industry can stand still and a forecast of growth is practicable. In this connection it may be noted that there is a marked realisation of the fact that quality and service are becoming the keynote rather than quantity, the cry of "quantity production" to the contrary notwithstanding. This is an additional argument for the "Foundry That Fits" and for the conservation of space and of consequent capital investment and for the utilisation to the maximum of existing facilities.

Design.

The proper layout must be housed by the building. This not only permits of a labour-saving occupancy, but calls for light, sanitation, ventilation and above all, economy.

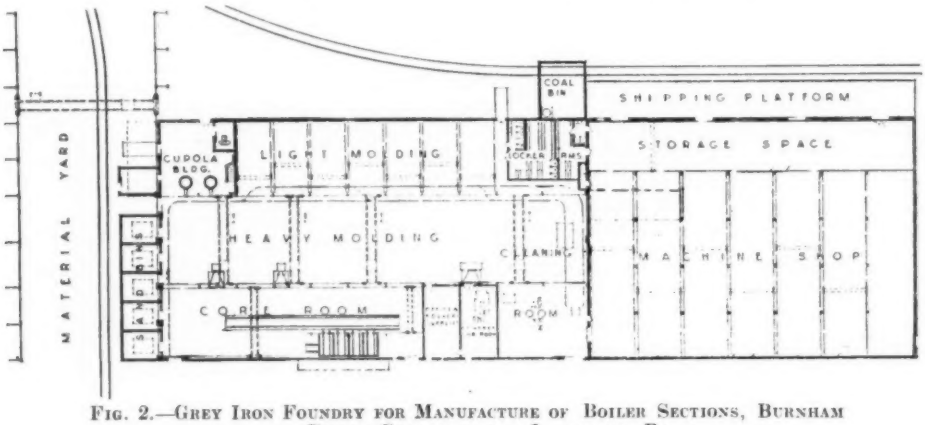


FIG. 2.—GREY IRON FOUNDRY FOR MANUFACTURE OF BOILER SECTIONS, BURNHAM BOILER CORPORATION, LANCASTER, PA.

There is no excuse for a poorly lighted and ventilated foundry. Good light is as essential in every step in the making of good castings, as in any other manufacturing process and can be secured usually with little expense. When foundries are made to be fit places for men to work in, there will be less difficulty in securing men to work in them. This fact is becoming recognised by progressive foundry executives. It is difficult to deal with details, in discussing a subject where every plant is a problem unto itself.

Buildings should, as a general rule, be fire resistant in construction. Wood has no place in a foundry building and its use is seldom an economy. Beyond this consideration, the cost of local building materials is a prime factor in cost and kind of buildings. No foundry is complete without proper sanitary conveniences. Toilets, lockers, showers, dressing rooms should be clean, well kept and conveniently located. Lunch and club rooms, medical facilities and housing for employees must receive more consideration and is receiving more every year.

Construction.

Proper plans, specifications and superintendence by a man competent to furnish these are requisite for the honest and rapid construction of a satisfactory plant. When it comes to buying a suit of clothes, instructing a lawyer, or ordering equipment for the plant, care is taken to get service of quality with the backing of a reputation and record of accomplishment, but when it comes to a building operation, an inexperienced architect whose "fee" is a trifle less than good practice requires and "the lowest bidder" make a combination responsible for many a costly building.

Foundry Planning for Economical Production.

Meeting of the Scottish Branch of the I.B.F.

At a recent meeting of the Scottish Branch of the Institute of British Foundrymen in Glasgow, a Paper was read by Mr. Evan J. Ross, Holm Foundry, Cathcart, on the subject of "Foundry Planning for Economical Production." At a subsequent meeting a discussion on the Paper took place. The chair was occupied by Mr. James Affleck, B.Sc., President of the Branch.

MR. LONGDEN said Mr. Ross's Paper certainly contained a great deal of information which represented first-class foundry practice. With regard to Fig. 9, however, Mr. Ross said that taking the corner out of a web was not very often done in cast iron. To his own knowledge, Mr. Longden said that was done twenty years ago by cylinder makers near Manchester. They placed these cores in the cylinders they made at that time. Nevertheless it was very valuable, and well worthy of study. Fig. 17 showed the core engaging the mould at the bottom line of the casting. It occurred to him that if that was green sand work, it was a very bad method indeed, for the simple reason that probably or occasionally the core would get out of the centre. There was one other illustration to which he would like to draw attention. In connection with Fig. 22 Mr. Longden asked how the weight of the core was carried. He presumed that it was a dry sand mould, and he thought that the little print at the outer end of the casting had to take up a great deal of the weight of the core, and that there was very little bearing for the core at the end. The tendency would therefore be for it to sag in the centre. He would much prefer to make that the other way up. He would like to ask Mr. Ross how the planning department of the foundry was organised. Were all these contrivances worked by very expert moulders or by the foundry foremen, or, alternatively, had it a staff of draughtsmen to itself? If it was not done by the foreman he had to get the work laid down and the patterns planned by a department over which he had no control. It seemed to him that there was not much room for a new department for that sort of work, but still it was very advantageous to have the thinking out of the work done before the job was started. It was really the application of commonsense to foundry practice, and it seemed to be work that could not be done outside the foundry manager's office.

MR. ROSS, in reply, said he did not think that the system was anything abnormal, but he did say that they knew what would be done in the foundry once the work was planned. They knew also very closely the cost and time to make cores and moulds. It had been said that Fig. 9 represented a practice that had been carried out for 20 years. He had done so himself for a considerable time, and he had also done so in the design of steel castings. He thought he was safe in saying that few draughtsmen realised the value of taking out the corners of a section of that kind. With regard to Fig. 17, he might say that prints of this type were used in green sand moulds: they found that they fitted very well, as good as sand would allow. The clearance at the bottom allowed for any little grip of the mould, and they worked them every day like that. Referring to Fig. 22, he had pointed out that there was a little neck of sand at the right hand end of the core. There was an opening nearer to the left hand end which helped to support the core, also a chaplet immediately under the door opening, this casting being only a light duty casting. The manner in which planning was carried out he had stated in the Paper he read. The foundry superintendent was consulted, and the foreman might be consulted if required. Generally speaking the duty and quality of the casting was first considered. The foundry foreman had to work with the patterns as arranged when planned and all arrangements were made for machine moulding. In that way matters worked smoothly, and they had few complaints.

MR. CHARTERIS said what he desired to know was what was done to bring out the capabilities of the highly skilled tradesman. Was the planning staff able to limit the amount of work expected from the man who was industrious, enthusiastic and highly skilled?

The CHAIRMAN explained that the planning department had nothing to do with labour or apprenticeship questions, but was concerned only with the actual development of methods.

MR. MARSHALL, referring to Fig. 19, said he supposed that was an example of foundry planning work. There were there two cores, and the one on the right hand side of the figure had another core inserted into it. He was inclined to think that the pressure of the metal would press the core back out of its place.

MR. ROSS pointed out that there was a clearance at B in drag mould. The clearance might be $\frac{5}{8}$, $\frac{3}{4}$ or 1 in., depending on the length of key at other end. The core was laid in and the key could then be slipped into the keyway. The clearance in the drag mould could be filled in with greensand. The cope mould had a clearance of about $\frac{1}{16}$ in. and there was no fear that the core would come back. The force was upwards and had a tendency to lift the core. He used that method very often and there was no tendency for a core to come back.

MR. LAURIE said they were all indebted to Mr. Ross for his Paper. The one thing that seemed clear was that there was an intelligence department in Messrs. G. and J. Weir's. The Paper showed them what they were up against when they got patterns in from the general engineer, who seldom considered the difficulties which had been referred to. Many jobs came into the foundry which were not just what the foundryman would like, and he had to form himself into a ways and means department in order to make that particular casting. There it was, and he was allowed no latitude but to make it as the pattern had come to him. It was a pity that there was not someone at the elbow of the designer to present the foundryman's point of view. Mr. Ross had an excellent grip of the foundry trade, and he knew what the foundry manager tried to embody in his work. But in time, he had no doubt, the foundryman would get hold of that end of the stick which was his due. In speaking of the bad design of a pattern, he said, they had to keep in mind the fact that the pattern-shop belonged to the engineering side of the business. One thing he might add was that where they got proper designs they could usually get the costs a good deal cheaper.

MR. PRIMROSE said they had listened to an excellent Paper, and his only hope, as he listened to Mr. Ross, was that the Paper would get into the hands of the engineers. Mr. Ross had the advantage of having a foundry and an engineering works combined. But in most foundries they were never allowed to touch a pattern, and in many cases they did not know what the castings were for. An interesting case had come under his own observation. His firm's traveller in the West of England wrote saying he could get an order for a large quantity of conveyor drums which were wanted at a certain price. He said that the company wanting these drums had tried several foundries and they had found porosity in the metal. If his firm wanted the work they could get it at a certain figure. In his view, with the pattern in question, Mr. Primrose could get nothing but porosity. So he wrote to the company suggesting that the pattern might be altered, but he got a curt note in reply saying that that could not be done. He took the work and altered the pattern, and just that morning he had received a letter from the company saying they were the finest castings they had ever had.

The CHAIRMAN in closing the discussion said that the planning scheme as outlined in Mr. Ross's Paper was obviously designed for a number of different classes of castings. It had clearly certain limitations when viewed from that standpoint. Mr. Ross did not put it forward as a "cure all" nor in any generalised sense, but merely as a way of handling certain problems. He (Mr. Affleck) could say, as one who had been associated with Mr. Ross in this class of work, that planning had solved these problems, and that

it was a success from the important point of view of £ s. d. He could assure Mr. Charters that the Planning Department was under the control of the foundry manager, who also controlled the pattern shop. Every attention is paid to the point of view of the practical man, and this was really the secret of Mr. Ross's success, as all along he had kept in close touch with the man handling the work in the foundry. The effect of this was very much greater than one would think. On the engineering side, the castings were utilised in a scheme organised more or less for mass production. Jigs were made for machining work, and accordingly the castings were required to be true to form so that they would drop easily into the jigs on the machines. A detailed study of costs previous to the institution of foundry planning showed that in some cases foundry costs represented about 60 to 70 per cent. of the total cost. This was partly due to excessive weights and to the production of castings in excess of drawing thicknesses. The system of foundry planning not only led to a distinct improvement in form of castings, but also to remarkable reductions in weight. If one could get ⅛ of an inch or even of an inch of metal off the surface of a casting all over, the weight was materially affected and also the cost. Mr. Ross has also shown very clearly the important effect of foundry planning on the design department of the engineering side. With regard to patterns, he added, pattern makers were not in the habit of being instructed as to the exact method in which a pattern was to be made. The usual method was to hand the pattern maker the job and let him make the pattern according to his own ideas, but in work of the class dealt with by Mr. Ross it was obviously not advisable to give the pattern maker full powers of this sort. One must consult with the moulder, with the engineer and with the designer, and the pattern must be made to suit the requirements of all as far as possible. Mr. Ross had most ably and most completely described a planning system as applied to a definite class of work, but it was clear that a similar system with modifications could be applied to other classes of work.

A vote of thanks was accorded to Mr. Ross for his Paper.

Book Review.

Kelly's Directory of Merchants, Manufacturers and Shippers of the World (2 vols.). Published by Kelly's Directories, Limited, 186, Strand, London, W.C.2.

This, the 39th edition of this well-known work, incorporates the results of all the experience gained through years to give the business man a thoroughly reliable medium. Thus a change has been made in the sections of Vol. II to speed up references by conforming to the following order: England, Scotland and Wales, London, Ireland, British Dominions, whilst the lists of exporters and importers are given at the end of each of the three first-named sections, instead of forming a separate section as previously.

The end sought by the publishers has been to give to persons speaking French, German or Spanish an intelligible work of reference. The directory is divided into two main self-contained sections, Vol. I taking Asia, Europe, Africa, America (Central, North and South, and the West Indies), whilst Vol. II is devoted to the British Empire.

A phase which we appreciate is the incorporation of the chambers of commerce throughout the world, for, after all, a firm desiring to do business in, say, Lyons, would be better advised initially to make contact with the local Chamber of Commerce before approaching the local firms.

The magnitude of the directory can best be gauged by pointing out that there are 4,810 pages, sometimes carrying as many as five columns. Those of our home readers who are developing foreign business or foreigners exporting to Great Britain will find this work a most useful book of reference.

Irish Foundry Conditions.

An Appeal to the Government.

As a result of Mr. Gratton's pioneer work together with the constructive interest shown by Dr. Moldenke, and our leaders on the subject, the case for the technical and industrial organisation of Irish foundries has crystallised into a definite appeal to the Free State Government, the owners, and educational authorities.

A number of the principal points of the covering letter and the appeal are set out below:—(1) It is suggested that the brass foundry trades should be included; (2) the conclusions arrived at in our leader of June 11 are quoted *in extenso*; (3) that any Irish organisation should be part of "the great Technical Republic, which should know no boundaries," or, in other words, be a part of the Institute of British Foundrymen; (4) a letter from the Irish Minister of Industry and commerce is enclosed which, whilst agreeing with Mr. Gratton's views, points out that it would be futile to offer advantages to a trade "of the need of which they are not conscious"; (5) a meeting is to be called in Dublin to consider (*a*) collaboration with the Ministry, (*b*) the formation of an organisation for the industrial and technical advancement of the trades; (6) the steps suggested are (*a*) co-operation with technical colleges for routine analyses and simple day-to-day research, (*b*) standardisation of tests so as to meet local conditions, (*c*) minimisation of overlapping of foundry jobbing casting work, (*d*) the International Test Bar situation, (*e*) modernising existing plants with reference to tariffs, wages and standardisation, (*f*) formation of an information bureau, (*g*) so far as technical matters are concerned to consider the formation of an Irish Branch of the Institute of British Foundrymen; (7) extended reference is made in a further enclosure to the advice given to Irish founders by Dr. Moldenke.

A quotation in the appeal refers to the initial difficulties and pits Irish ability to organise against British, which is unfair. Even twenty-two years ago, when the Institute of British Foundrymen was started, the British industry was infinitely greater than in Ireland to-day. The Irish organisers must bear in mind that the jobbing foundries of Great Britain are only just beginning to realise that co-operate effort is worth while. In Ireland it may be best to look at the problem from the standpoint of the creation of new industries on the groundwork of existing plants.

We sincerely wish Mr. Gratton every success in his laudable endeavour. We can assure Irish foundrymen that anything which existing British organisations can do to help them technically will be most cordially undertaken if they will only apply.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Re Income Tax Depreciation Allowance.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—The announcement that the Government intend to insert in the Finance Bill a clause enabling depreciation and/or obsolescence to be given in respect of plant and machinery will prove most welcome to persons assessed in respect of professions or vocations. It has for too long been the law that such depreciation could be deducted in the case of a trade or business only, and the Royal Commission recommended so long ago as 1920 that the allowance should no longer be restricted to traders. Now that it is proposed to extend the principle to professional men, the difficulty of securing an equitable allowance in respect of motor cars will disappear.—Yours, etc.,

W. R. FAIRBROTHER,
Income Tax Specialist.

67-68, Cheapside,
London, E.C.2.

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Aiton & Company, Limited, Derby, one portable; Thos. Allan & Sons, Limited, Thornaby-on-Tees, one tractor; W. H. Allen, Sons & Company, Limited, Bedford, one portable; Sir W. G. Armstrong, Whitworth & Company, Limited, Newcastle, one portable; Sir W. G. Armstrong, Whitworth & Company, Limited, Manchester, one portable.

Bergius Company, Limited, Glasgow, one tractor; J. & T. Boyd, Limited, Glasgow, one tractor; *Braintree Castings Company, Limited, Braintree, one stationary; British Thomson-Houston Company, Limited, Rugby, one portable.

Callendar Iron Company, Limited, Falkirk, one tractor; Clapham Bros., Limited, Keighley, one portable; M. Cockburn & Company, Limited, Falkirk, two tractors; Crofts, Limited, Bradford, one tractor; Crofts, Limited, Bradford, one portable.

*Darlington Forge Company, Limited, Darlington, one portable; Davy Bros., Ltd., Sheffield, one portable; Dean, Smith & Grace, Limited, Keighley, one portable; Doulton & Company, Limited, Paisley, one tractor.

Falkirk Iron Company, Limited, Falkirk, three tractors; Forth & Clyde & Sunnyside Iron Company, Limited, Falkirk, two tractors.

Glenfield & Kennedy, Limited, Kilmarnock, one stationary; Grangemouth Iron Company, Limited, Falkirk, one tractor.

David King & Sons, Limited, Glasgow, one tractor; *Kryn & Lahy Metal Works, Limited, Letchworth, one portable.

Leys Malleable Castings Company, Limited, Derby, one tractor.

Markham & Company, Limited, Chesterfield, one portable; Morris Motors, Limited, Cowley, one stationary; M'Dowall, Steven & Company, Limited, Falkirk, two tractors; Walter Macfarlane & Company, Glasgow, one tractor.

*National Steel Foundry (1914), Limited, Leven, one tractor; Newton, Chambers & Company, Limited, Sheffield, one tractor.

Paisley Foundry Company, Paisley, one portable; Planet Foundry Company, Limited, Manchester, one tractor; Robert Potter & Sons, Limited, Glasgow, one tractor.

Saunders & Conner (Barrhead), Limited, Barrhead, one tractor; Smith, Patterson & Company, Limited, Blaydon-on-Tyne, one tractor; Stanton Iron Company, Limited, Stanton, one portable; Staveley Coal & Iron Company, Limited, Chesterfield, three portables; Sterling Metals, Limited, Coventry, one tractor.

Wilsons & Mathiesons, Limited, Leeds, one tractor.

Colonial and Continental Users.

Australia, eight machines; India, one machine; Belgium, fifteen machines; Holland, two machines; Switzerland, two machines; France, one machine; Germany, six machines.

Foundry Query.

Power for Shot Blast.

We find it necessary to use a shot blast apparatus to clean our steel castings, and may say that the shot blasting plant installed is found to be an extremely expensive apparatus to operate.

We use a 20-h.p. motor for the compressor, and a 20-h.p. exhauster, and as they are working at full load most of the time, our consumption in electric units is 36 units per hour at a cost of 1.1 of a penny per unit.

We should like advice as to any satisfactory type of shot blast which does not call for this big outlay of power, and which perhaps uses mechanical methods to lift the shot rather than the air suction.—A.B.C.

* Steel castings.

Company News.

General Electric Company, Limited.—Ordinary dividend, 7½ per cent., less tax, for year.

R. Hood, Haggie & Company, Limited.—Interim dividend, 6 per cent. actual on ordinary.

Midland Iron Company, Limited.—Loss, £6,732; brought forward, £1,303; deficiency, £5,429.

Schill Brothers, Limited.—Dividend, 6½ per cent. per annum, less tax. on preference shares for half-year.

Dickinson, Good & Company, Limited, Holme Street, Great Grimsby, Lincs.—Capital £5,000 in £1 shares. Ironfounders.

Dickson & Mann, Limited.—Debit balance, £7,026 carried forward, showing decrease £1,555, being profit for year, after deducting £400 for depreciation.

Maco Template & Engineering Company, Limited, Audrey House, Ely Place, E.C. Capital £2,000 in £1 shares (1,000 10 per cent. preference and 1,000 ordinary).

Edgar Allen & Company, Limited.—Net profit, £33,422; preference dividend, £15,000; ordinary dividend, 2½ per cent., free of tax, £10,211; carry forward, £15,754.

Murray & Company (Glasgow), Limited, 248, Hope Street, Glasgow.—Capital £2,000 in £1 shares. Engineers. Directors: Agnes Murray, C. S. Gray and H. G. Lawson.

Consolidated Steel Company, Limited, 105, Queen Street, Sheffield.—Capital £2,500 in £1 shares. Steel manufacturers and merchants. Directors: H. Hobson and E. J. Pode.

J. T. Watson, Limited, Livesay Fold Engineering Works, Darwen.—Capital £2,000 in £1 shares. Engineers. Directors: J. F. Watson, H. Watson and J. R. T. Watson.

Twyfords, Limited.—Accounts cover 15 months; profit, £54,416; dividend, 10 per cent. per annum and bonus 2½ per cent., £41,834; reserve, £6,840; carry forward, £39,346.

Workman, Clark & Company, Limited.—Loss for year, £182,960; debenture interest, £193,421; further reserve for taxation, £150,000; debit balance on profit and loss, £2,571,925.

Brasshouse Engineering Company, Limited, 180, Spring Hill, Birmingham.—Capital £3,000 in £1 shares (1,300 6 per cent. cumulative preference and 1,700 ordinary). Engineers.

Chas. Haley & Company, Limited, Diamond Street Foundry, Bradford.—Capital £4,000 in £1 shares. Ironfounders. Directors: C. Haley, Mrs. M. H. Haley and N. W. Green.

Cardiff Channel Dry Docks and Pontoon Company, Limited.—Dividends, 5 per cent. cumulative and 7 per cent. non-cumulative preference; credit of profit and loss account, £57,599, carried forward.

Filters, Limited, 811, Abbeydale Road, Sheffield.—Capital £2,000 in £1 shares. Manufacturers of filters for turbo-alternators and colliery air compressors, etc. Directors: G. Machin and C. C. McKinley.

Norwich Metal Manufacturing Company, Limited, 52, Calvert Street, Norwich.—Capital £3,000 in £1 shares. Metal founders, moulders, metal plate rollers, etc. Directors: C. J. Allday, H. O. Bennett, J. D. Freeman and W. C. Webster.

William Beardmore & Company, Limited.—Net loss, £503,094; brought forward, £608,092; credit of profit and loss account, £104,998; interim dividend to June 30, 1924, on preference shares (free of tax), £45,876; carried forward, £59,122.

North London Valve Company, Limited, 22½, Cazenove Road, Stoke Newington, London, N.16.—Capital £500 in £1 shares. Ironfounders, mechanical and electrical engineers, etc. Directors: F. A. Goulding, S. F. Game and K. H. Lewis.

Russell Edwards & Company, Limited, 65, Garden Walk, Ashton-on-Ribble, Preston, Lancs.—Capital £6,000 in £1 shares (1,500 7 per cent. cumulative preference). Iron and steel merchants, etc. Director: R. Edwards (permanent managing director).

Jennings (Birmingham), Limited.—Capital £1,000 in £1 shares, to carry on the business of manufacturers and factors of fancy and general brass foundry and metal-ware appliances for dairies, caterers, etc. Registered office: 156, Edmund Street, Birmingham.

Falkirk Iron Company, Limited.—Net profit, £28,466; brought in, £24,612; depreciation, £7,258; balance of expenses of formation and debenture issue, £5,770; dividend, 10 per cent. per annum, less tax, on ordinary and employees' shares; carried forward, £21,910.

Walker, Grifith & Company, Limited.—Capital £5,000 in £1 shares. Steel manufacturers, converters and rollers, ironmasters, etc. Directors: E. Walker, Clivedon, Tapton House Road, Sheffield, and E. Grifith. Solicitor: J. D. Bryce, 41, Norfolk Street, Sheffield.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Movements in the Cleveland iron market during the past week have developed a rather better tone, and though prices again declined to a small extent, business on the whole may be reported steadier. As is usually the case towards the close of the quarterly period, consumers' stocks are generally at a low ebb, and some measure of replenishment is now necessary to keep works going. Thus there have been slightly better sales, and where an inducement has been offered, some buyers have been willing to negotiate for three months' supplies. There is still a good deal of foreign competition, and French and Luxemburg iron is offered at prices far below those quoted by Cleveland makers. However, there are now a few more inquiries from the Baltic ports, and the volume of foreign business, though still limited, shows signs of expansion. Prices may be indicated, as follow :—No. 3 Cleveland G.M.B., 72s. 6d. per ton; No. 1, 76s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s. per ton.

In the Tees-side hematite market makers still complain of a slow demand, now scarcely sufficient to absorb the current output. In fact, there are still substantial stocks to be liquidated. Apparently makers have determined to make a stand against the further depression of prices, and as a general quotation are adhering to 77s. 6d. for mixed numbers, and 78s. for No. 1, though possibly attractive business could still be placed at something below these figures. Conditions on the West Coast are about similar to those above described, and prices have receded somewhat, Bessemer mixed numbers being now quoted at 85s. per ton c.i.f. Welsh ports, 89s. per ton delivered at Glasgow, 92s. per ton delivered at Sheffield, and 96s. per ton delivered at Birmingham.

LANCASHIRE.—The position in the local markets for foundry pig continues unrelieved from the prevailing depression, with buying only on a minimum scale. Some very low prices for Lincolnshire iron are reported, but Derbyshire sellers were steady at 80s. delivered. No doubt the stronger sellers will continue to hold out for 80s., or, at any rate, will positively assert that they are doing so, but makers in want of orders will no doubt have to meet competition by price concessions.

Metals.

Copper.—Following the recent interval of weaker values, the standard market has returned to more steady levels of about £60 per ton, from which the variations at present are merely fractional either way. The comparative limitation of supplies appears to be the principal factor supporting the market, as there is not much in the way of increased consumption to warrant any particular firmness. In addition to the recently reported curtailment of production comes the announcement that there has been a considerable encroachment on stocks in the United States, and this has most decidedly had an effect on the position. Current quotations :—*Cash* : Thursday, £59 15s.; Friday, £59 10s.; Monday, £59 17s. 6d.; Tuesday, £60; Wednesday, £60 2s. 6d.

Three Months : Thursday, £60 15s.; Friday, £60 10s.; Monday, £60 17s. 6d.; Tuesday, £61; Wednesday, £61 2s. 6d.

Tin.—Standard values in tin have been subject of late to somewhat erratic fluctuations, but on the whole the market remains steady. Obviously recent reactionary conditions have induced more caution in the filling of trade needs, while there does not appear to be much to be reasonably expected in the way of new stimulating features in the early future. Professional operations of an aggressive character on either side of the market would seem to have been given a rest for the moment, so that the trend of prices is more dependent on the character of the consumptive demand. Current quotations :—*Cash* : Thursday, £251 2s. 6d.; Friday, £250 15s.; Monday, £253 2s. 6d.; Tuesday, £252 15s.; Wednesday, £253. *Three Months* : Thursday, £253 5s.; Friday, £252 15s.; Monday, £255 5s.; Tuesday, £255 2s. 6d.; Wednesday, £255 5s.

Spelter.—In the market for this metal the outlook is obscure, and, with production and consumption still quite evenly balanced, there appears little prospect of much movement in price either way. Occasionally covering purchases have been the means of making a better market, but demands from manufacturers do not yet show any material signs of increasing, being content to cover only immediate requirements rather than anticipate further need. Current quotations :—*Ordinary* : Thursday, £34 1s. 3d.; Friday, £34 2s. 6d.; Monday, £34 6s. 3d.; Tuesday, £34 7s. 6d.; Wednesday, £34 5s.

Lead.—Movements in soft foreign pig continue somewhat irregular, with values slightly on the down grade. The recent rather heavy decline has caused some surprise in certain quarters, but has no real significance. The market since the closing days of May had been on the up-grade and the prompt position early rose above £34. Cable makers bought fair quantities of the commodity for July arrival at £34 5s., c.i.f., and the sudden fall which followed must be ascribed to the weaker news from the United States and the heavier arrivals in this country. Current quotations :—*Soft foreign (prompt)* : Thursday, £33 1s. 3d.; Friday, £33 2s. 6d.; Monday, £33 11s. 3d.; Tuesday, £33 11s. 3d.; Wednesday, £33 3s. 9d.

Obituary.

MR. M. W. HENTY, recently managing director of Vivian & Sons, Limited, and afterwards chairman of British Copper Manufacturers, Limited, died recently, aged 49.

MR. J. H. PETERSEN, C.B.E., has died at his residence, Calthorpe Road, Edgbaston, aged 52. He was a director of the Centaur Tool Works, Limited, Birmingham. He had been in poor state of health for several weeks, though he was at business as recently as Tuesday of last week.

MR. W. R. GREEN died at his residence, Brook House, Ecclesfield, on June 29. Mr. Green, who was 74, and had been ill a long time, was well known in the business circles of Sheffield and district. He was head of the well-known firm of W. Green & Company, owners of the Norfolk Foundry and Ironworks, Ecclesfield, and also of West Bar, Sheffield. He was closely connected with the public life of the area.

MR. T. E. G. MARLEY, who died in London on June 19, aged 73 years, was, until quite recently, actively connected with the Workington Bridge and Boiler Company, Limited, since its formation as a company. He was for a number of years managing director of the Whitehaven Hematite Iron and Steel Company, Limited, also a director of John Whittle & Company, Limited, and the Cumberland Waste Heat Owners, Limited. During the war period he served on the managing board for the West Cumberland Shell Factory, and for a period was chairman of the West Coast Iron Committee and the West Coast Ironmasters' Association.

Personal.

MR. D. B. GEBBIE has been appointed general manager of the Furness Shipbuilding Company. Mr. Gebbie recently resigned the position of managing director of the New Waterway Shipbuilding Company, of Rotterdam, when there ceased to be British interests in that company.

MR. E. BEAN, who has been connected with Messrs. Earle's Shipbuilding and Engineering Company, Limited, of Hull, for many years, has been appointed foundry manager of the Abadan Works, Persia, of the Anglo-Persian Oil Company. Mr. Bean, who is a well-known member of the Institute of British Foundrymen, sailed last Saturday week.

SIR PHILIP NASH, chairman, and Mr. P. N. Rand, general sales manager, of the Metropolitan-Vickers Electrical Company, Limited, have returned by the "Aquitania" from their six weeks' tour in the United States of America. The object of their visit, we understand, was to study the electrical conditions in that country in relation to similar developments in Great Britain, as well as to meet their manufacturing friends and to discuss future development.

Wills.

WALLWORK, R., of Henry Wallwork & Company, engineers, Manchester	£19,041
HARVEY, R., lately chairman of Harvey Engineering Company, Glasgow	£74,302
DICKINSON, J. C., late of John Dickinson & Sons, Limited, of Palmers Hill, Sunderland	£173,250
SWINNEY, T., of Woodside, director of Swinney Bros., Limited, ironfounders and engineers	£21,193
CLEEVES, F., of Cleeves' Western Valleys Anthracite Collieries, Limited, now absorbed by the Amalgamated Anthracite Collieries, Limited	£160,490

THE ELECTRIFICATION of the Eaglescliffe Foundry of Head, Wrightson & Company, Limited, has been completed, and now all the company's works are electrically equipped.

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Naphthaline Tablets,
Hot Pressed Naphthalene,
Naphthalene Flakes,
Naphthalene Powder,
Cresylic Acid,
Crude Carbolic Acid,
Nitre Cake,
Salt Cake,
Pyridene
Sulphate of Copper,
Sulphate of Iron,
Red Oxide of Iron,
Bleaching Powder,
Caustic Soda,
Accumulator Acid,
Creosote Oil,
Green Oil, Pitch,
Sulphate of Ammonia,
Muriate of Ammonia,
B.O.V. & R.O.V.
Oleum (all strengths),
Pure Sulphuric Acid,
Nitric Acid,
Disinfectant Powder.

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"STAVEHO" for Waterproofing Cement Work.

YOUR ENQUIRIES ARE INVITED.

ON ADMIRALTY, WAR OFFICE, CROWN AGENTS AND INDIA OFFICE LISTS.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	60	2	6
Three months	61	2	6
Electrolytic	63	15	0
Tough	62	5	0
Best selected ..	62	15	0
Sheets	90	0	0
India	77	5	0
Wire bars ..	64	0	0
Do. July ..	63	15	0
Do. Aug. ..	63	15	0
Ingot bars ..	63	10	0
H.C. wire rods	67	15	0
Off. av. cash, June	59	19	2 5/7
Do., 3 mnths., June	60	18	9
Do. Sttlmnt, June	59	18	9 5/8
Do., Electro, June	63	11	5 1/2
Do., B.S., June	63	1	11 1/2
Aver. spot price copper, June	59	19	2 3/4
Do., wire bars, June	63	15	5 1/2
Solid drawn tubes			13d.
Brazed tubes ..			13d.
Wire			10d.

BRASS.

Solid drawn tubes	11 3/4d.
Brazed tubes ..	13 1/2d.
Rods, drawn ..	10 1/2d.
Rods, extd. or rlld.	7 1/2d.
Sheets to 10 w.g.	10 1/2d.
Wire	9 5/8d.
Rolled metal ..	9 1/2d.
Yellow metal rods	7 1/4d.
Do. 4 x 4 Squares	8 1/2d.
Do. 4 x 3 Sheets	9d.

TIN.

	£	s.	d.
Standard cash	253	0	0
Three months ..	255	5	0
English ..	253	5	0
Bars	256	0	0
Straits	256	0	0
Australian ..	255	5	0
Eastern ..	258	5	0
Banca	258	5	0
Off. aver. cash, June	252	11	8
Do., 3 mths., June	253	19	8 3/4
Do., Sttlmnt. June	252	12	7 7/8
Aver. spot., June	252	11	8

SPELTER.

	£	s.	d.
Ordinary ..	34	5	0
Remelted ..	34	0	0
Hard	29	0	0
Electro 99.9 ..	39	0	0
English ..	34	15	0
India	30	10	0
Zinc dust ..	42	0	0
Zinc ashes ..	14	10	0
Off. aver., June	33	17	4 13/14
Aver., spot, June	34	2	11 1/2

LEAD.

	£	s.	d.
Soft foreign ppt.	33	3	9
English ..	34	10	0
Off. average, June	33	4	6 3/7
Average spot, June	33	9	7

ZINC SHEETS, &c.

Zinc sheets, English	40	0	0
Do. V.M. ex whf.	40	0	0
Dutch		—	
Rods	46	0	0
Boiler plates ..	40	0	0
Battery plates	39	0	0

ANTIMONY.

Special brands, Eng.	84	10	0
Chinese ..	64	10	0
Crude	51	0	0

QUICKSILVER.

Quicksilver ..	14	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon	
45/50% ..	13 2 6
75%	22 5 0
Ferro-vanadium—	
35/40% ..	16/- lb. va
Ferro-molybdenum—	
70/75% c. free	7/- lb.
Ferro-titanium—	
23/25% carbonless	1/- lb.
Ferro-phosphorus, 20/25%,	£23 0 0
Ferro-tungsten—	
80/85 %, c. fr. ..	1/5½ lb.
Tungsten metal powder—	
98/99%	1/9 lb.
Ferro-chrome—	
4/6% car. ..	£24 5 0
6/8% car. ..	£23 12 6
8/10% car. ..	£23 5 0
Ferro-chrome—	
Max. 2% car.	£43 0 0
Max. 1% car.	£52 10 0
Max. 0.70% car.	£57 5 0
70%, carbonless	1/5 lb.
Nickel—99%, cubes or pellets	£170 to £175
Cobalt metal—98/99%	10/3lb.
Aluminium 98/99%	£120
Metallic Chromium—	
96/98% ..	3/9 lb.
Ferro-manganese (net)—	
76/80%, loose	£15 10 0
76/80%, packed	£16 10 0
76/80%, export	£15 0 0
Metallic manganese—	
94/96%, carbonless	2/-lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over ..	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼ in. to ⅛ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do. under ½ in. × ¼ in.	1/-lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces ..	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Hvy. steel	3 5 0 to 3	7 6
Bundled steel & shrngs.	3 2 6 to 3	6 0
Mixed iron & steel	£3 0 0 to 3	2 6
Heavy cast iron ..	3	7 6
Good machinery for foundries ..	3	15 0
Cleveland—		
Heavy steel ..	3	0 0
Steel turnings ..	2	5 0
Cast-iron borings	2	1 3
Heavy forge ..	4	5 0
Bushelled scrap	3	10 0
Cast-iron scrap ..	3	15 0
Lancashire—		
Cast-iron scrap ..	3	15 6
Heavy wrought ..	3	15 0
Steel turnings ..	2	5 0

London — Merchants' buying prices delivered yard.

Copper (clean) ..	52	0	0
Brass (clean) ..	39	0	0
Lead (less usual draft)	29	0	0
Tea lead ..	25	0	0
Zinc	22	0	0
New aluminium cuttings ..	92	0	0
Braziery copper	47	0	0
Gunmetal ..	48	0	0
Hollow pewter ..	163	0	0
Shaped black pewter	115	0	0

PIG-IRON.

(f.o.t. unless otherwise stated).

N.E. Coast—	
Foundry No. 1 ..	76/6
Foundry No. 3 ..	72/6
Foundry No. 4 ..	71/6
Forge No. 4 ..	71/-
Hematite No. 1 ..	78/-
Hematite M/Nos. ..	77/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	89/-
,, d/d Birm. ..	96/-
Midlands—	
Staffs. common* ..	102/-
,, No. 4 forge ...	70/-
,, No. 3 foundry	72/6
Shrops. basic ..	85/-
,, Cold blast, ord.*	190/-
,, ,, roll iron*	195/-
* d/d Birmingham.	
Northants forge ..	63/-
,, fdry No. 3 ..	66/9
Derbyshire forge ..	69/6
,, fdry No. 3 ..	72/9
,, basic	75/-
Scotland—	
Foundry No. 1 ..	87/6
,, No. 3 ..	82/6
Hem. M/Nos. ..	85/6
Sheffield (d/d district)—	
Derby forge ..	75/-
,, fdry. No. 3 ..	76/6
Lincs. forge ..	—
,, fdry. No 3 ..	79/-
E.C. hematite ..	87/6
W.C. hematite ..	92/6
Lincs. (at furnaces)—	
Forge No. 4 ..	—
Foundry No. 3 ..	73/-
Basic	72/-
Lancashire (d/d eq. Man.)—	
Derby forge ..	79/3
,, fdry. No. 3 ..	80/-
Northants foundry No. 3 ..	80/3 to 80/6
Dalzell, No. 3 ..	111/6
Summerlee, No. 3 ..	100/-
Glengarnock, No. 3	100/-
Gartsherrie, No. 3 ..	100/-
Monkland, No. 3 ..	100/-
Coltness, No. 3 ..	100/-
Shotts, No. 3 ..	100/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.)	11 12 6 to 13	0 0
Angles	12	7 6
Tees to 3 united ins	13	2 6
Nut and bolt	11	15 0
Hoops	14 0 0 to 15	0 0
Marked bars (Staffs.) f.o.t. ..	14	10 0
Gas strip ..	13	0 0
Bolts and nuts, ⅜ in. × 4 in. ..	16	15 0
Steel—		
Ship plates	8 15 0 to 9	5 0
Boiler plts.	£12 10 to 13	0 0
Chequer plts.	£10 10 to 11	0 0
Angles	£8 5 0 to 8	12 6
Tees	£9 5 0 to 9	12 6
Channels	£7 15 0 to 8	5 0
Joists	£8 5 0 to 8	12 6
Rounds and Squares 3in. to 5½in. ..	9	5 0
Rounds under 3 in. to ⅜ in... ..	9	0 0
Flats, over 5 in. wide and up ..	9	15 0
Flats, 5in. to 1½in.	8	15 0
Rails, heavy ..	8	10 0
Fishplates ..	12	10 0
Hoops (Staffs.) £11 0 0 to	11	10 0
Black sheets, 24g.	11	15 0
Galv. cor. sheets, 24g.	16 5 0 to 16	10 0
Galv. fencing wire 8g. plain ..	14	0 0
Billets, soft	6 10 0 to 8	5 0
Billets, hard ..	9	0 0
Sheet bars	6 12 6 to 6	15 0
Tin bars d/d	6 12 6 to 6	15 0

PHOSPHOR BRONZE.

	Per lb.	bas.
Strip	1	2¾
Sheet to w.g. ..	1	3½
Wire	1	3½
Rods	1	2½
Tubes	1	7
Castings	1	2

Delivery 3 cwt. free.

10% phos. cop. £40 above B.S.

15% phos. cop. £50 above B.S

Phosphor tin (5%) £30 above price of English ingots.

C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G. ..	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated. Dols.

No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	19.76
No. 2 foundry, Birm.	20.00
Basic	19.76
Bessemer	20.76
Malleable	20.26
Grey forge	19.26
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess. billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	35.00
Wire rods	46.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.40
Sheets, black, No. 28 ..	3.15
Sheets, galv., No. 28 ..	4.25
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.70
Plain wire	2.90
Barbed wire, galv. ..	3.45
Tinplate, 100 lb. box ..	$5.50

COKE (at ovens).

Welsh foundry ..	37/6
,, furnace	27/6
Durham & North.	
,, foundry ..	35/-
,, furnace ..	17/-
Other Districts, foundry	35/-
,, ,, furnace (Basis)	13/6

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20 × 14, box	19/9
,,	28 × 20, ,,	39/-
,,	20 × 10, ,,	28/3
,,	18¾ × 14, ,,	20/7½
C.W.	20 × 14, ,,	17/9
,,	28 × 20, ,,	35/4½
,,	20 × 10, ,,	24/9
,,	18¾ × 14, ,,	18/4½

Terneplates 28 × 20, 1/3 per box basis below tinplates.

SWEDISH IRON.

Bars, hammered	£20/0 to £21/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£10 to £14
Pig-iron	£6 15 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES.

Up to and incl. 6 in.

Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.	
June 25	59	15	0	dec. 5/-
,, 26	59	10	0	,, 5/-
,, 29	59	17	6	inc. 7/6
,, 30	60	0	0	,, 2/6
July 1	60	2	6	,, 2/6

Electrolytic Copper.

	£	s.	d.	
June 25	63	12	6	No change
,, 26	63	0	0	dec. 12/6
,, 29	63	15	0	inc. 15/-
,, 30	63	15	0	No change
July 1	63	15	0	,, ,,

Standard Tin (cash).

	£	s.	d.	
June 25	251	2	6	dec. 32/6
,, 26	250	15	0	,, 7/6
,, 29	253	2	6	inc. 47/6
,, 30	252	15	0	dec. 7/6
July 1	253	0	0	inc. 5/-

Tin (English ingots).

	£	s.	d.	
June 25	252	10	0	dec. 15/-
,, 26	252	5	0	,, 5/-
,, 29	254	5	0	inc. 40/-
,, 30	254	0	0	dec. 5/-
July 1	253	5	0	,, 15/-

Zinc Sheets (English).

	£	s.	d.	
June 25	40	0	0	No change
,, 26	40	0	0	,, ,,
,, 29	40	0	0	,, ,,
,, 30	40	0	0	,, ,,
July 1	40	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
June 25	34	1	3	dec. 1/3
,, 26	34	2	6	inc. 1/3
,, 29	34	6	3	,, 3/9
,, 30	34	7	6	,, 1/3
July 1	34	5	0	dec. 2/6

Lead (English).

	£	s.	d.	
June 25	34	10	0	dec. 5/-
,, 26	34	10	0	No change
,, 29	34	15	0	inc. 5/-
,, 30	34	15	0	No change
July 1	34	10	0	dec 5/-

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Yearly Average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1887	37 5	35 10	34 4	34 4	34 1	34 10	34 4	34 5	33 9	31 10	31 8	33 6	34 2
1888	32 2	31 1	31 5	31 9	30 11	31 5	32 4	33 5	34 8	34 2	33 11	33 10	32 7
1889	33 8	35 0	37 5	38 9	38 6	37 10	40 1	43 4	44 1	51 5	64 7	61 1	43 10
1890	60 3	53 1	51 0	47 4	42 2	41 5	43 2	45 7	47 9	47 10	47 4	43 1	47 6
1891	42 1	41 10	39 9	38 7	40 9	41 0	40 8	39 8	40 4	39 11	38 8	38 1	40 1
1892	37 7	35 7	36 10	37 10	39 2	40 11	39 11	39 10	40 0	38 6	37 6	37 4	38 5
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 0
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7¾	49 6¾	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	58 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7½
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	91 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 1 7½
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6¾
1924	99 10	97 3¾	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2¾	81 9	81 9	88 7⅛
1925	80 4¾	78 10½	78 0	77 3¾	76 0	73 10½	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SITUATIONS VACANT AND WANTED.

FOUNDRY FOREMAN.—A situation wanted by a first-class Man; up to date in Foundry management and the control of men, Mixing and Melting of Metals; excellent references.—Box 372, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

METALLURGIST wanted for Motor-car Works' Laboratory; sound knowledge of Heat Treatment and Metallography of Steel essential.—Applications, which will be treated with strict confidence, should state age, previous experience and salary required, to Box 376, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED, three or four good all-round Iron Moulders for Marine and General Jobbing Shop, Cardiff district; constant employment for suitable men. —Write, stating experience, with references, to Box 374, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

ADVERTISER, holding Honours and Research degrees in Science, age 32, considerable technical and commercial experience, particularly in Non-Ferrous work, having been Works Manager and Research Metallurgist for several years, seeks position with progressive firm desiring to increase quality and quantity of output.—Apply, Box "C. Q.," Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

IRON FOUNDRY Foreman and Core Shop Chargehand wanted; piecework shop; machine moulding and jobbing work of the highest class; state fully class of work experienced in, sands, etc., age and salary; shop employs about 50 men; London district; young men without experience as supervisors will be considered if they have had good technical and practical experience.—Apply, Box 362, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

BRASS FOUNDRY Foreman, for shop near London employing 10 to 15 men and making first-class castings in small and medium weights for engineers' use; must be able to produce sound castings to War Office and Admiralty specifications.—State very fully experience, practical and technical, age, salary, etc., to Box 364, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY.

SAND MIXERS.—New and secondhand. Ask us to quote.—W. BREALEY & COMPANY, LTD., Russell Street, Sheffield.

FOR SALE, Two Britannia Jar Ram Moulding Machines; capacity, 10 cwt. at 80 lbs pressure; pattern draw 8 in.; condition as new; price, £50 each. —Box 360, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FURNACES FOR SALE.—Six M.R.V. 440 lb. Tilting Furnaces, with accessories; in good working condition.—Apply PICKETT CONSTRUCTION CO., Lovell's Wharf, Pelton Road, E. Greenwich, London, S.E.10.

MACHINERY, PLANT, &c.

POWERFUL HORIZONTAL DOUBLE-GEARED STEAM WINCH, by Clarke, Chapman & Co.; 4 cyls., 11 in. diam. by 12-in. stroke; diam. of drum, 2 ft. 6 in. x 3 ft. face.

Two HORIZONTAL DOUBLE-GEARED STEAM WINCHES, by Clarke, Chapman & Co.; 7-in. cyls., 12-in. stroke; drum, 24 in. diam. x 33-in. face.

Seven nearly new HOISTING AND TRAVERSING PETROL WINCHES, by Hy. Bergerat & Co., for loads up to 10 cwts.; two independent barrels.

POWERFUL MOTOR-DRIVEN WINCH, by Clarke, Chapman & Co.; drum, 3 ft. 6 in. diam., 3 ft. face, driven by motor, 450 amps., 100 volts, 520 revs.

NEARLY NEW STEEL LANCASHIRE BOILER, 30 ft. x 9 ft.; reinsurable at 100 lbs. working steam pressure; complete with steam and furnace fittings, etc.

FOUR LANCASHIRE BOILERS, 30 ft. x 8 ft.; reinsure 150 lbs. pressure.

VERTICAL COCHRAN LAND-TYPE BOILER for gas-firing, 16 ft. 3 in. high x 7 ft. 6 in. diam.; working pressure, 80 lbs. per sq. inch.

CATALOGUE OF STOCK MACHINERY, 6,000 Lots. Free on Application. Inspection Invited.

THOS W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

SALES BY TENDER.

ROBERTS & COOPER, LTD.
(In Voluntary Liquidation),
GREAT BRIDGE IRON WORKS, TIPTON.

The Liquidator offers for Sale by Tender either LOT A.—The FREEHOLD LAND at Great Bridge, comprising the above-mentioned Great Bridge Iron Works and all Buildings, Mills, Machinery and Erections thereon, and all the Tools, Plant, Utensils, Office Furniture and loose Chattels therein and thereon, or LOT B.—The WORKING PLANT, MACHINERY, TOOLS and Loose EFFECTS on and about the said Works.

PLANT AND MACHINERY INCLUDE :—

(1) Puddling Forge, with 20 Furnaces, two Steam Hammers, 11 Boilers and Steam Ranges, and Boiler Feed Pumps, powerful Steam Engine, together with two Rolling Trains and necessary equipment to produce Bars from 2 in. to 15 in. wide.

(2) 16-in. Bar and Strip Mill, with two Furnaces; one Lancashire Boiler and Steam Range and Feed Pump; powerful Engine and Mill Equipment to produce Strip and Bars from 2 in. to 15 in. wide.

(3) 10-in. Merchant and Guide Mill, with two Furnaces; Lancashire Boiler, Steam Range and Steam Pump, powerful Engine with Condenser attached; Mill Equipment to produce Bars and Sections.

(4) Self-contained Condenser Plant and Engine.

(5) Electric Lighting Plant.

(6) Roll Turner Lathes, Tools and Engine, Plant, etc.

Forms of Tender and Conditions can be obtained on application to the Liquidator, T. H. GOUGH, ESQ., Chartered Accountant, of 267, Castle Street, Dudley; MESSRS. GOUGH, SON & CLARE, Chartered Accountants, 44, High Street, Brierley Hill; or MESSRS. SLATER & CAMM, Solicitors, 198, Wolverhampton Street, Dudley.

CITY OF HULL.
OLD TRAMWAY RAILS.

The Corporation are prepared to receive offers for about 600 tons of Old Girder Tramrails, original weight about 96 lbs. per yard, which will be taken up from Hedon Road in the course of the ensuing six months or thereabouts.

Forms of Tender and other particulars may be obtained of the undersigned.

Tender, endorsed "Offer for Old Rails," to be addressed to the Chairman of the Tramways Committee, and delivered at the Town Clerk's Office, Hull, on or before Thursday, 9th July, 1925.

The Corporation do not bind themselves to accept the highest or any tender.

By Order,
F. W. BRICKNELL,
City Engineer.

Guildhall, Hull,
27th June, 1925.

MISCELLANEOUS.

PATTERNS.—Inquiries solicited; quotations by return; quick delivery. Castings also supplied, if required, in all metals.—CLEGHORN & CO., Spring Gardens, Worcester.

J & R. FLEMING, LTD
Wholesale Suppliers of
SAFETY GOGGLES
PROTECTION WHICH HELPS BUT DOES NOT HINDER.
A GOOD GOGGLE FOR EVERY JOB.
146 CLERKENWELL ROAD, LONDON, E.C.1

JOLT RAMMING MACHINES.

One No. 0 BRITANNIA with pattern draw - £18
Two No. 1 BRITANNIA with pattern draw, ea. £32
Four TABOR plain shockless 4" jolters, ea. £16
One EVANS shockless 32"×24" *turnover* jolter with 12" pattern draw, fine machine - - £90
One TABOR (14" cyl.) shockless 48"×32" *turnover* jolter with 26" pattern draw - - £180
Two MACDONALD (7" cyl.) turnover jolters to take boxes 40"×24" Ajax type - - ea. £120

All above Machines are in GOOD condition.

BUY FROM ME & ***SAVE MONEY.***

ALEX. HAMMOND,
FOUNDRY MACHINERY MERCHANT,
"BOXTED," SLOUGH.
'Phone: 287 Slough.